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MAN. 43

TOWN ENERGY AUDIT MATCH

MG / 13230

83.153
MARCH 1985

MANITOBA/CANADA CONSERVATION AND RENEWABLE ENERGY DEMONSTRATION AGREEMENT

The availability of secure and affordable energy supplies is a subject of national concern. It is an accepted fact that our primary energy sources — oil and natural gas — are becoming less accessible and more costly. However, Canada is well-endowed with renewable and alternative resources that can provide a bridge into the future.

To this end, the governments of Manitoba and Canada entered into a Conservation and Renewable Energy Demonstration Agreement which was signed May 9, 1980 and terminated March 31, 1984. The Agreement was dedicated to the development and demonstration of conservation and renewable energy technologies. Equally cost-shared by the provincial and federal governments, the program had a total budget of $18-million.

The objectives of CREDA are:

- To develop and demonstrate promising new technologies, which, when widely adopted, will exploit renewable resources, conserve energy and/or use energy more efficiently.
- To develop broad public awareness of the potential of renewable energy and conservation technology.
- To provide opportunities for the commercial application of the technologies within Manitoba.
- To create economic spin-off benefits for manufacturing, industry and commerce.
- To create employment in new or existing energy-related industries.

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SUMMARY

T.E.A.M., the Town Energy Audit Match, was a multi-sector, energy conservation pilot project carried out under the Conservation and Renewable Energy Demonstraton Agreement (CREDA) between the Government of Canada and the Province of Manitoba. Its broad objectives were to demonstrate the potential of energy conservation in two Manitoba communities and make available the acquired knowledge to other communities in Canada. T.E.A.M. considered the residential, municipal, industrial, commercial, institutional and transportation sectors.

The T.E.A.M. project was carried out in the towns of Pinawa and Stonewall. Commencing in late 1983 and continuing for approximately one and a half years, each sector of these towns was subjected to detailed energy audits to identify opportunities for energy savings. To encourage participation and a sense of community involvement, T.E.A.M. was staged as a competition between the two towns with the winner receiving a cash award to assist with a major energy conservation retrofit.

Under the Residential Module, an audit delivery system was established using 24 people hired and trained specifically for this purpose. During the project they performed 641 residential audits, representing 50% of the housing stock in the two towns. As part of the Municipal Module, five municipal facilities in each town were audited with one in each town receiving a major conservation retrofit. The Transportation Module consisted of Fuel Economy Diagnostic Clinics in which 878 vehicles had their engine performance evaluated, engine timing and air/fuel mixture adjusted and tire pressure checked. The Industrial/Commercial/Institutional Module provided energy audits to 42 buildings using the Energy & Mines Energy Bus (part of the National Energy Audit Program). A Statistical Base Module was also created to monitor the effects of the other modules and to administer the competition-related aspects of the project.

The T.E.A.M. project provided valuable insights on the delivery of energy conservation programs and generated a better understanding on how future energy conservation programs, either single or multi-sector, could be delivered.

RÉSUMÉ

J.E.U., le Jeu Énergétique Unique, était un projet pilote de conservation d'énergie dans plusieurs secteurs, réalisé dans le cadre de l'Accord de démonstration des économies d'énergie et des énergies renouvelables (ADEEER) conclu entre le Canada et le Manitoba. Les objectifs généraux du projet consistaient à démontrer l'importance des économies d'énergie qui pouvaient être effectuées dans deux agglomérations manitobaines et à mettre les renseignements obtenus à la disposition des autres agglomérations du Canada. Le programme J.E.U. englobait les secteurs résidentiel, municipal, industriel et commercial, ainsi que ceux des établissements d'État et du transport.

Le projet J.E.U. s'est déroulé dans les villes de Pinawa et de Stonewall, commençant vers la fin de 1983 et se prolongeant sur une période d'environ un an et demi. Chaque secteur de ces deux agglomérations a fait l'objet d'un contrôle énergétique rigoureux afin de déterminer les divers moyens d'économiser de l'énergie. Pour inciter la population entière à participer au projet et lui donner le sentiment de faire oeuvre communautaire, le J.E.U. a été présenté comme une compétition entre deux villes, dont la gagnante se verrait attribuer une récompense monétaire pour l'aider à entreprendre un important projet de réfection en vue d'économiser l'énergie.

Dans le module résidentiel, 24 personnes ayant reçu une formation spéciale ont été embauchées pour mettre sur pied ce système de contrôle. Au cours du projet, elles ont procédé à la vérification de 641 habitations, représentant 50% du parc de logements de ces deux villes. Dans le module municipal, cinq installations dans chaque ville ont été vérifiées et l'une d'elle, dans chaque ville, a fait l'objet d'une réfection importante en vue d'économiser l'énergie. Le module du transport comprenait des ateliers de diagnostic sur l'économie d'essence, au cours desquels 878 véhicules ont fait l'objet d'une évaluation du rendement du moteur, d'un réglage de l'allumage et du mélange air-essence et d'une vérification de la pression de gonflage des pneus. Dans le module industriel-commercial-établissements d'État, on a procédé à la vérification du rendement énergétique de 42 immeubles au moyen du véhicule de vérification du rendement énergétique (Énergiebus) d'Énergie et Mines (qui fait partie du Programme canadien de vérification du rendement énergétique). On a également mis sur pied un module statistique afin de contrôler les effets des autres modules et de gérer le projet sous son aspect compétition.

Le projet J.E.U. a permis d'obtenir de précieux renseignements sur la réalisation des programmes de conservation d'énergie et sur les améliorations à apporter aux programmes futurs dans un ou plusieurs secteurs.

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SECTION 1
INTRODUCTION

1.1 BACKGROUND

Implementation of energy conservation technologies and practices has grown significantly in recent years. Armed with increasingly accurate information on the subject, various sectors of society have employed conservation to protect themselves from rising energy costs. Various conservation strategies have been demonstrated through numerous programs, research projects and field studies. From these efforts has evolved a better understanding of energy conservation which recognizes its benefits, costs and secondary effects.

Historically, the majority of these activities had been directed towards individual sectors at a time. Relatively few projects had attempted to implement energy conservation on a community-wide basis. None had done so within Manitoba. Recognition of this fact and the acknowledgement of the potential benefits from a multi-sector demonstration were the impetus for the creation of the T.E.A.M. project.

T.E.A.M., the Town Energy Audit Match, was a pilot project carried out under the Conservation and Renewable Energy Demonstration Agreement (CREDA) between the Government of Canada and the Province of Manitoba. Its broad objectives were to demonstrate the potential of energy conservation in two sample Manitoba communities and make available the acquired knowledge to other communities in Canada. T.E.A.M. considered the residential, municipal, industrial, commercial, institutional and transportation sectors.

The T.E.A.M. project was carried out in the towns of Pinawa and Stonewall. Commencing in late 1983 and continuing for approximately one and a half years, each sector of these towns was subjected to detailed energy audits to identify opportunities for energy savings.

1.2 T.E.A.M. PROJECT OBJECTIVES

The primary objectives of the T.E.A.M. project were to demonstrate, assist and encourage energy conservation in two Manitoba communities with a major emphasis on reducing energy consumption.

An additional objective was to record and report the project achievements for the purpose of information and technology transfer to other communities in Manitoba and Canada.

1.3 REPORT STRUCTURE

This report has been prepared to document the events and experiences of the T.E.A.M. project and to summarize some of the insights gained during its delivery. Each energy sector (municipal, transportation, residential, etc.) has been designated as a study module with a separate section of the report devoted to each module. To aid readers in identifying those sections which will be of most interest to them, a short description of the report contents is presented below.

- Section 1 offers a general introduction to the T.E.A.M. program and its background.
- Section 2 is a summary of the major events which occurred and offers a brief review of the five major delivery modules, the project organization and responsibilities, and a short description of the two towns. It will provide background for all readers.
- Section 3 presents the Residential Module, which was the largest module in the program, and includes a review of the residential energy audit program established in the towns. It also outlines audit procedures, energy auditor hiring and training and program delivery.
- Section 4 provides a review of the Municipal Module and the energy audits performed on municipal facilities in the towns.
- Section 5 discusses the Transportation Module and the Fuel Economy Diagnostic Clinics held to reduce energy use in the transportation sector.

- Section 6 is a summary of the Industrial/Commercial/Institutional Module.

- Section 7 reviews the Statistical Base Module which controlled the competition-related aspects of the T.E.A.M. project. It also includes a discussion of the estimated energy savings produced by T.E.A.M.

- Section 8 considers some of the lessons learned about the delivery of community energy audit programs. It will be of interest to those involved with the planning and delivery of such projects.

- Section 9 summarizes the major lessons learned from the T.E.A.M. experiences.

- Appendix A contains descriptions of the two towns.

- Appendix B contains copies of the residential energy audit worksheets and recommendation forms.

- Appendix C contains copies of the Engine Performance Test Reports and Diagnostic Reports used in the Transportation Module.

- Appendix D contains the T.E.A.M. Competition Guidelines.

- Appendix E contains the Final Point Standings.

SECTION 2
THE T.E.A.M. PROJECT

2.1 INTRODUCTION

The need for a multi-sector demonstration of energy conservation had been recognized for some time by both the Federal and Provincial Governments. The possibility of funding such a project under CREDA led to discussions in the spring of 1983 between Energy, Mines and Resources Canada (EMR) and Manitoba Energy & Mines (E & M). This led to the formal decision to proceed with a project which became known as the Town Energy Audit Match or T.E.A.M.

To insure that the necessary infrastructures and resources were locally available, two towns with populations between 2,000 and 3,500 people were considered most appropriate to serve as the demonstration communities for the project. To provide further incentives, the project was structured around a competition between the two selected towns. Detailed planning of T.E.A.M. began shortly thereafter.

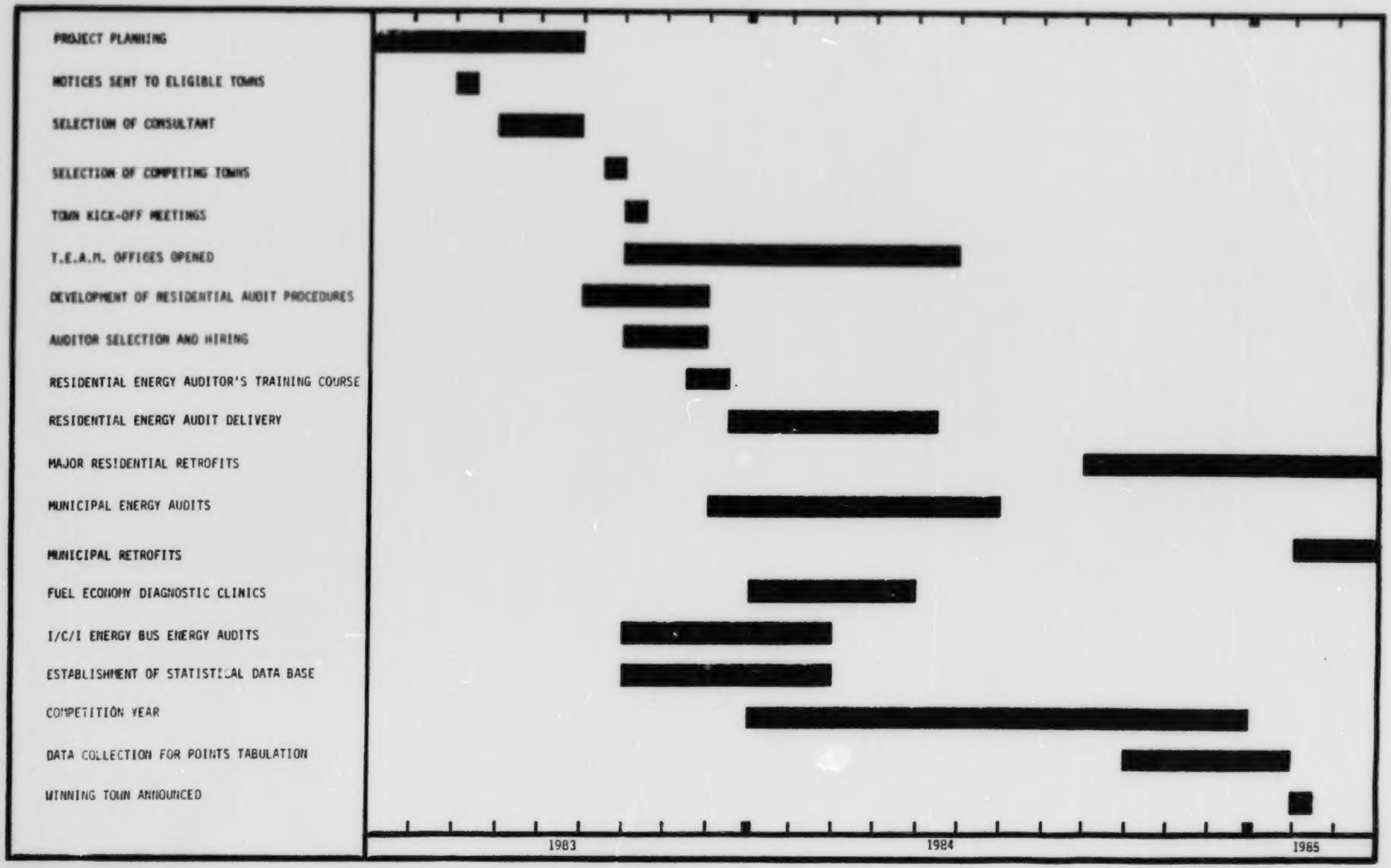
A historical summary of the project and a general overview of its major components is presented below. A summary of events is shown in Figure 2.1. More detailed discussions of each activity are provided in later sections.

2.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

A description of the project organization is shown in Figure 2.2. Overall responsibility rested with the Project Management Committee which was composed of representatives of EMR and E & M. Day-to-day management was performed by E & M. On technical aspects of the project delivery, E & M was assisted by a Consultant group composed of UNIES Ltd., Appin Solar Associates Inc., and E.J. Faraci and Associates Ltd.. Within each town, a Steering Committee was established to communicate with E & M and organize the town's input to the project. A more detailed description of

FIGURE 2.1

HISTORICAL SUMMARY OF THE T.E.A.M. PROJECT



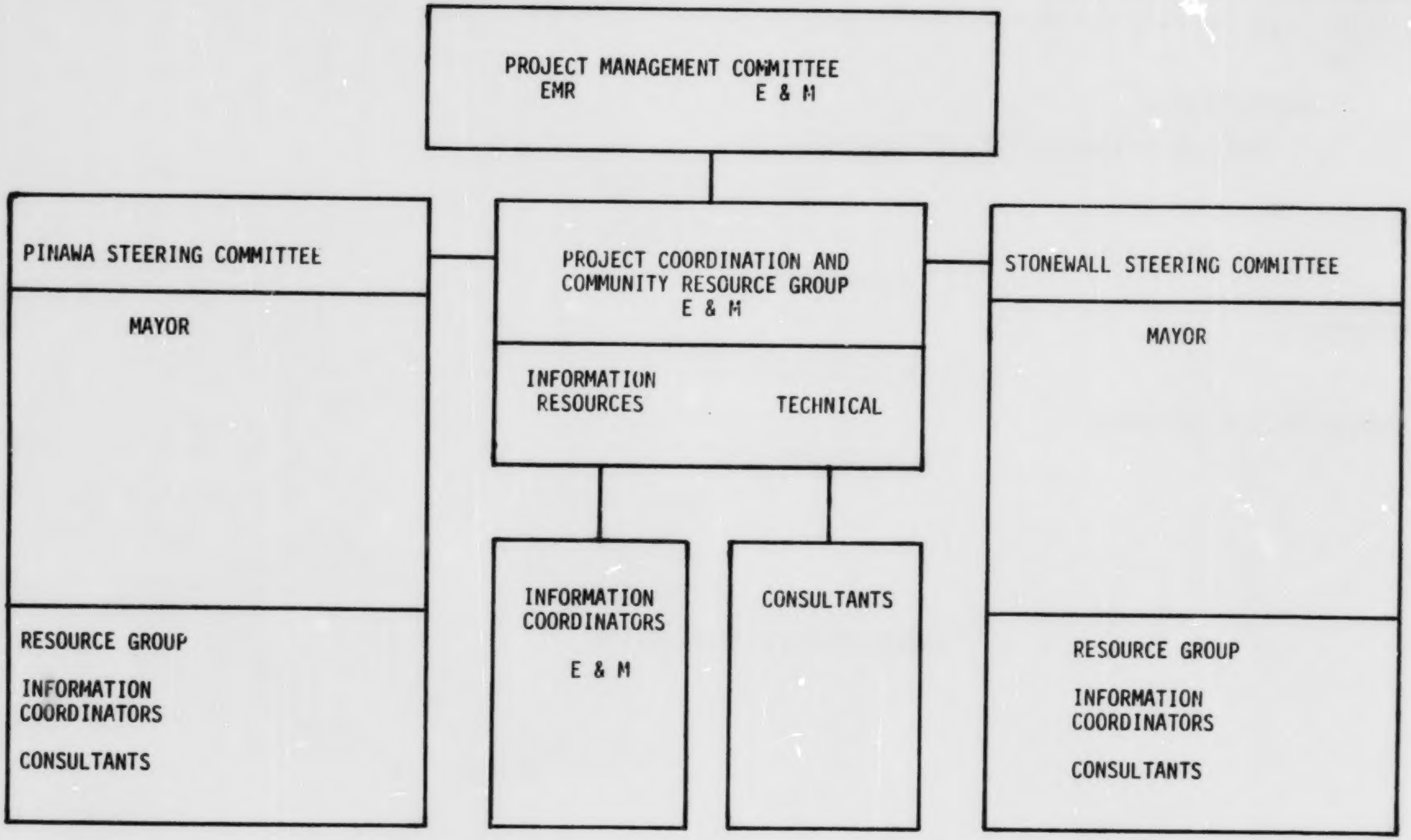

PROJECT MANAGEMENT COMMITTEE
EMR
E & M
PINAWA STEERING COMMITTEE
MAYOR
RESOURCE GROUP
INFORMATION COORDINATORS
CONSULTANTS
PROJECT COORDINATION AND COMMUNITY RESOURCE GROUP
E & M
INFORMATION RESOURCES
TECHNICAL
INFORMATION COORDINATORS
E & M
CONSULTANTS
STONEWALL STEERING COMMITTEE
MAYOR
RESOURCE GROUP
INFORMATION COORDINATORS
CONSULTANTS

FIGURE 2.2

T.E.A.M. PROJECT ORGANIZATION

the major responsibilites follows:

Project Management Committee (Energy, Mines and Resources Canada; Manitoba Energy & Mines)	- Project design - Overall responsibility
Manitoba Energy & Mines	- Day-to-day management - Liason with Town Steering Committees - Operation of T.E.A.M. Information Offices in each town - Information transfer - Liaison with Consultants - Energy Bus audits
Town Steering Committees	- Organization and coordination of town input - Selection of municipal facilities to be retrofitted - Cost-sharing of municipal retrofits
Consultants	- Hiring, training and administration of residential energy audit staff (UNIES/Appin) - Management of residential retrofits (UNIES/Appin) - Municipal audits and retrofits (Faraci) - Fuel Economy Diagnostic Clinics (Faraci) - Coordination with Energy Bus (Faraci) - Data collection, Competition Guidelines and judging of competition (Appin/UNIES/Faraci) - Reporting (UNIES/Appin/Faraci)

2.3 SUMMARY OF EVENTS

2.3.1 Project Planning and Preparation - Planning of the T.E.A.M. project commenced in the spring of 1983. The project was structured into five delivery modules, with the first four designed to provide energy conservation services to the respective sectors of each community and the fifth to quantify the results of the project. Module titles were as follows:

1. Residential Module
2. Municipal Module
3. Transportation Module
4. Industrial/Commercial/Institutional Module
5. Statistical Base Module

Once the major parameters and scope of the project were defined, formal notification of the project was sent, in late June, 1983, to the mayors of the eleven Manitoba towns deemed eligible for T.E.A.M. This notification described the project in detail and noted the benefits which the successful towns would receive. Interested towns were requested to complete an application which documented their interest and identified the input they were willing to provide. Since most direct project costs were covered by T.E.A.M., this input was expected mainly to take the form of active participation and support by town officials, local service groups and individual citizens. Selection of the two towns was noted as being very dependent on the degree of community involvement in the project. Although the general scope of T.E.A.M. had been established, every opportunity was made to encourage local input and innovation.

Completed applications from interested towns were received during July, 1983. Following review of the applications by E & M, Pinawa and Stonewall were selected as the competing towns. Brief descriptions of both are included in Section 2.4.

Day-to-day management of T.E.A.M. was the responsibility of E & M. To assist with program delivery, E & M decided to contract the services of a Consultant with the required experience. Accordingly, a Request for Proposals was issued in July, 1983 for these services. Following receipt and review of the proposals, a Consultant group composed of UNIES Ltd., Appin Solar Associates Inc. and E.J. Faraci & Associates was selected. UNIES and Appin were responsible for the Residential Module, E.J. Faraci for the Municipal, Transportation and Industrial/Commercial/Institutional Modules, and Appin for the Statistical Base Module. UNIES served as head of the Consultant group.

With the major participants identified and announced, public meetings were held in the two towns during October, 1983 to describe the project to the townspeople. At approximately the same time, Information Offices were opened in each town. These were designed to serve as administrative centers and establish a visible presence for the project.

At this point, work commenced simultaneously on the delivery of each of the five modules. A short summary of each follows. More detailed descriptions follow in later sections of this report.

2.3.2 Residential Module - The primary vehicle used to encourage residential energy conservation was a free energy audit service available to all homeowners in the towns. Since it was anticipated that this would result in several hundred audits, 24 people were hired by the Consultant to be trained as residential energy auditors and dispatchers. To provide instruction, a 3½ week Residential Energy Auditor's Training Course was developed and delivered from November 16 to December 9, 1983. Upon completion of the course, residential energy audits commenced in both towns and extended to May, 1984. During this period, 345 residential audits were performed in Pinawa and 296 in Stonewall.

To provide further information to homeowners, two technical seminars were also held in each town during February. These described various aspects of residential energy conservation techniques.

A second and minor objective of this Module was to demonstrate conservation techniques by performing a small number of major residential retrofits in each town. Accordingly, two houses in Pinawa and four in

Stonewall were retrofitted to meet a goal of a minimum 30% reduction in their total predicted annual energy use. Reasons for this different number of retrofits in each town are discussed later. The retrofits were cost-shared on a 50/50 basis (up to $8,000) between the homeowner and the T.E.A.M. program.

2.3.3 Municipal Module - The main component of this module was an energy audit of five municipal facilities in each town, performed at no cost to each town. The facilities were selected by the Town Steering Committees on the advice of the Consultants and the T.E.A.M. Management Committee. Once the audits had been completed and the findings reviewed, facilities in each town (the Pinawa Community Centre and School; and the Stonewall and District Health Centre and the Community Curling Club) were selected to receive retrofits. Each town also received general input assistance from the Consultants on other measures to save energy in town buildings and facilities which had not been audited.

2.3.4 Transportation Module - Fuel Economy Diagnostic Clinics were held in each town from January to April, 1984. These were open to residents of both towns. A total of 453 vehicles were processed in Pinawa and 425 in Stonewall. Each had its engine performance determined using a Sun Micro II analyzer. Minor adjustments to the engine timing and air/fuel mixture were made along with any necessary adjustments to tire pressure. These free clinics were performed by local garages under contract to the Consultants.

2.3.5 Industrial/Commerical/Institutional Module - Energy audits were made available to all buildings in this sector using the E & M Energy Bus, part of the National Energy Audit Program. Audits were performed in the towns between October, 1983 and February, 1984. During this period, the Energy Bus audited 12 out of the 16 eligible buildings in Pinawa and 30 out of the 90 eligible in Stonewall.

2.3.6 Statistical Base Module - The objectives of this module were to estimate the effectiveness of the various modules and to administer the various competition-related aspects of the project. Statistical data on the towns was collected and combined with estimates of energy use from the other modules to predict pre- and post-T.E.A.M. energy consumption. Estimates of the energy savings due to T.E.A.M. were then calculated. The T.E.A.M. competition year was the 1984 calendar year. A set of Competition Guidelines was developed to administer the contest and to permit identification of the winning town.

2.4 DESCRIPTION OF TOWNS

Pinawa is located 121 km northeast of Winnipeg and has a population of 2,011. A unique community, Pinawa was constructed in 1963 by Atomic Energy of Canada Ltd. (AECL) to provide a home for employees of the Whiteshell Nuclear Research Establishement. Pinawa is a single industry town with over 85% of the workforce employed by AECL. As it is a young town, all buildings and facilities are of recent vintage. Construction standards, existing conservation levels, etc. show little variation. Electricity and oil are the two most commonly used energy sources. Some wood is also used for residential space heating. Natural gas is not available in Pinawa.

Stonewall is located 32 km north of Winnipeg and has a population of 2,210. As a farm service centre for the surrounding area, Stonewall has numerous small businesses and industries. Many residents are employed in Winnipeg and commute daily. The town displays a wide range of building construction styles, conservation standards and building age. The primary energy sources are natural gas and electricity with some wood used for residential space heating.

More detailed descriptions of both towns are attached in Appendix A.

SECTION 3
RESIDENTIAL MODULE

3.1 INTRODUCTION

To meet the project objectives in the residential sector, an energy audit service was made available to homeowners in each town. There was no charge for this service. Since the towns contained 1,273 houses, a formal audit delivery system, including the hiring and training of auditors, had to be established.

The activities of the Residential Module can be broken down into seven components:

- Development of energy audit procedures
- Auditor selection and hiring
- Residential Energy Auditor's Training Course
- Audit delivery
- Major retrofits
- Seminars
- Administration

3.2 DEVELOPMENT OF ENERGY AUDIT PROCEDURES

Since the residential energy audits were delivered by previously untrained staff, a series of audit procedures were developed to define the scope, objectives and methods by which audits were to be performed. These procedures were designed to describe all the major components of the audit from initial homeowner contact to presentation of final results.

To provide background on typical procedures, a number of residential energy audit programs and related projects which had been delivered in Canada and the United States were reviewed. Although most had differed in scope from T.E.A.M., they still provided useful information.

The major source of technical input for T.E.A.M. was derived from the experiences of E & M, EMR and the Consultants under the Energy Demo - Home Energy Saving Demonstration Program (Ref. 1). Energy Demo was a CREDA-funded project carried out prior to T.E.A.M. and was designed to demonstrate residential energy conservation alternatives in Manitoba. Under Energy Demo, 154 privately owned houses had been subjected to detailed energy audits that included airtightness tests and analysis of various retrofit alternatives using the HOTCAN residential energy analysis computer program. From this group of 154, 83 houses were subsequently retrofitted using a variety of energy conservation techniques.

Following review of the referenced programs and the Energy Demo experiences the major characteristics of the T.E.A.M. audits were defined:

Audit Type - Emphasis on qualitative aspects of the analysis.

Scope - Primary emphasis on space heating loads with lesser emphasis on hot water heating and appliance energy use.

Scheduling - Audit date and time arranged by a dispatcher. Initial visit to house by two auditors who examined structure, made necessary measurements, interviewed homeowners and identified possible conservation opportunities. Analysis and preparation of report for homeowner prepared at office. Presentation to homeowner by single auditor.

Testing - Measurements of air and hot water temperature, relative humidity and smoke pencil examinations for air leakage sources, where possible. No blower door airtightness tests, furnace efficiency tests, infra-red scans or other measurements performed.

Method of Analysis - Hand calculations using standardized worksheets and basic analysis techniques. Purpose of analysis to estimate energy and dollar savings of conservation options and corresponding simple payback periods.

Recommendations - Emphasis on no-cost and low-cost measures and cost-effective options.

Presentations - Hand-written report presented to homeowner summarizing audit findings supported with appropriate technical literature.

These energy audit procedures are described in more detail in Section 3.5.

3.3 AUDITOR SELECTION AND HIRING

Auditor selection and hiring were the responsibility of the Consultant. The staffing requirements for delivery of the residential energy audits were as follows:

20 auditors
2 supervisors
2 dispatchers

These positions were advertised in five local newspapers and with local Manpower offices. As a result 118 applications were received, 48 from the Pinawa area and 70 from the Stonewall area. Each application was pre-screened on the basis of technical skills, communication skills, initiative and the overall impression of the written application. Townspeople were given preference for the positions in an effort to encourage local interest in the T.E.A.M. project.

Forty-one applicants passed the pre-screening process and were interviewed to further assess their capabilities and experience. All interviews were conducted by a two man team and documented for future reference. Final selection of the successful applicants was then made.

The two supervisor positions were not filled until after the training course had been completed and the capabilities of the employees better assessed.

In general, a wide range of individuals with varying backgrounds were chosen for the audit staff positions. Technical experience ranged from minimal to extensive. Communication skills were considered to be above average. Personal attitudes towards the project and its goals were judged to be very positive and enthusiasm was high for the majority of the successful candidates.

3.4 RESIDENTIAL ENERGY AUDITOR'S TRAINING COURSE

To train the staff members in their roles, a 3½ week training course was conducted. The T.E.A.M. Residential Energy Auditor's Training Course consisted of: a 3 day at-home study period, two weeks of formal classroom lectures with site visits and practice exercises and a one week period of supervised practice audits. The course ran from November 16, 1983 to December 9, 1983.

The objective of the Residential Energy Auditor's Training Course was to prepare the students for their roles as energy auditors. Within the context of the T.E.A.M. project, this was defined as the ability to assess the potential for energy conservation within the house, (recognizing the financial constraints and interests of the homeowner plus any associated maintenance considerations), priorize these opportunities in terms of their relative payback periods, and provide the homeowner with advice on how best to implement the recommendations. Students were explicitly instructed that the course objective was not to train them as building inspectors, servicemen or assessors. Residential energy auditing was stressed as an occupation which, although having some common ground with these trades, had to be considered a unique service.

The training course was based on two related courses developed by Canada Mortgage and Housing Corporation:

> "Training in Housing Rehabilitation Skills; Course 1 - Inspecting Dwellings and Introduction to Specification Writing" (Ref. 2) and
>
> "Training in Housing Rehabilitation Skills; Course 3 - Energy Conservation in Rehabilitation". (Ref. 3)

These two courses, with their supporting manuals, were developed by CMHC for training Residential Rehabilitation Assistance Program inspectors and delivery agents. They were chosen for T.E.A.M. because they were considered the most relevant, provided comprehensive details of residential construction practices and energy conservation techniques, and contained clear explanations. Since they had not been specifically designed for training of energy auditors, supplemental material, mainly in the form of added lecture content, was included. Instruction was performed by the

Consultants with support from guest lecturers.

A schedule for Weeks 1, 2 and 3, the formal lecture and practice audit periods, is shown in Figure 3.1. Week 1 of the course focused on a review of house design and construction practices to provide the students with a thorough understanding of construction fundamentals. The first two days of training concentrated on the various aspects of house construction. On the third day, the students conducted site visits in small groups, to apply what they had learned. Using standardized inspection sheets, they were required to document the types and styles of construction, maintenance problems, etc. They were also asked to identify any opportunities for energy conservation, even though this subject had not been discussed in detail. Virtually all discussion during the first three days was qualitative. On the fourth and fifth days, basic building physics was introduced. This dealt with topics such as heat transfer, energy balances, etc. It also provided an introduction to the calculation procedures used to perform an energy audit.

The second week's training concentrated on energy conservation techniques and included discussions of appropriate retrofit measures and materials, as well as exercises on the analysis procedures used to perform an audit. For most students, these calculations were the most difficult aspect of the course. In addition to having problems with basic mathematics, most students required considerable time to become comfortable with the abstract concepts of mathematical representation. To apply the analysis procedures, two site visits were conducted in which groups of students performed trial energy audits and produced written reports. Week 2 also included lectures on communications and dealing with the public. The students were coached on how to communicate their recommendations properly and how to deal with unexpected situations such as:

- Homeowners who had a poor command of the English language
- Domestic disputes which erupted in the middle of the audit
- Accusations of house damage or other problems

FIGURE 3.1

RESIDENTIAL ENERGY AUDITOR'S TRAINING COURSE SCHEDULE

WEEK 1

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
INTRODUCTION - introduction to T.E.A.M. project - course intent, goals objectives and methods	HEATING SYSTEMS - module IV course 1 - alternate systems, wind, solar, heat exchangers	SITE VISIT (4 rotating groups) - bungalow	PRESENTATION OF SITE ASSESSMENT - student presentations	REVIEW CALCULATOR EXERCISES
THE ASSESSMENT OF EXISTING CONDITIONS - module 1 course 3 - inspections	HEATING - systems - wood heat - safe heating systems	SITE VISIT - 1½ story wood frame	CALCULATOR AND MATH EXERCISES	BASIC BUILDING PHYSICS - module II course 3 - air change - heat balance
				BASIC BUILDING PHYSICS - simplified calculations procedures
LUNCH - 1.5 HRS.	LUNCH - 1 HR.	LUNCH - 1 HR.	LUNCH - 1 HR.	LUNCH - 1 HR.
THE BUILDING STRUCTURE - module II course 1 - systems, problems, inspections	THE ELECTRICAL SYSTEM - module V course 1 - service entrance, distribution, fixtures, inspections	SITE VISIT - split level	METRIC REVIEW	EXERCISES AND REVIEW OF CALCULATION PROCEDURES
THE PLUMBING SYSTEM - module III, course 1 - supply, drainage, venting, fixtures, inspections	THE BUILDING ENVELOPE - module VI course 1 - principles, components, problems, inspections	SITE VISIT - UFFI house	BASIC BUILDNG PHYSICS - module II course 3 - conduction heat loss	BASIC BUILDING PHYSICS - airtightness, ventilation, air quality - human comfort - passive solar - retrofits and building operations
	SITE VISIT PREPARATION - objectives and goals	COURSE REVIEW AND ASSESSMENT	ASSIGN CALCULATOR AND MATH EXERCISES	COURSE REVIEW AND ASSESSMENT
EVENING	EVENING	EVENING	EVENING	EVENING
		WRITE SITE ASSESSMENT - individual reports on on 1½ storey house	EXERCISES - complete exercises at home	

FIGURE 3.1

RESIDENTIAL ENERGY AUDITOR'S TRAINING COURSE SCHEDULE

WEEK 2

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
REVIEW GOALS AND OBJECTIVES	RETROFIT MEASURES AND MATERIALS - heating systems, hot water system, electrical system, ventilation system	ASSESSMENT OF COMPLETED RETROFIT WORK - module V course 3 - materials, air sealing, insulation	SITE VISITS AND AIR LEAKAGE DEMONSTRATIONS - house #1 - Pinawa	CASE STUDY PRESENTATION BY GROUPS
FICTIONAL FIELD CASE STUDY - procedures, information gathering, analysis and reporting - hand out information for exercise in simplified calculations	COST-BENEFIT ANALYSIS - module IV course 3 - pay backs - fuel costs	ASSESSMENT OF COMPLETED COST-BENEFIT ANALYSIS - air/vapour barrier, windows and doors	SITE VISITS - house #2	TEAM AUDIT PROCEDURES AND PROCESSES
LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
RETROFIT MEASURES AND MATERIALS - module III, course 3 - materials, air sealing, basements, floors	EXERCISES ON COST-BENEFIT ANALYSIS	COMMUNICATIONS - dealing with homeowner - questions, transferring information	CASE STUDY EXERCISE OF HOUSE #2 - calculations - evaluations	GOVERNMENT FUNDING PROGRAMS
	APPLIANCE USE AND SELECTION	PREPARATION FOR SITE VISITS		T.E.A.M. COMPETITION GUIDELINES
	COURSE REVIEW AND ASSESSMENT			REVIEW AND ASSESSMENT OF COURSE BY STUDENTS
EVENING	EVENING	EVENING	EVENING	EVENING
STUDENTS TO DO EXERCISES IN SIMPLIFIED CALCULATIONS AND PROCEDURES			EXERCISE - complete exercises at home	

FIGURE 3.1

RESIDENTIAL ENERGY AUDITOR'S TRAINING COURSE SCHEDULE

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	WEEK 3
AUDIT VISITS - 3 Homes - 3 Groups of Auditors - Information Gathering	AUDIT VISITS - 3 Homes - 3 Groups of Auditors - Information Gathering	REVIEW AND DISCUSS THE AUDIT PROCESS As Two Persons Teams - Speedy/Accurate info gathering - Info analysis - Presentation to home-owner of info	PROCEDURES - Dispatcher - Co-ordinator - Auditors - Interaction and processes and forms	REVIEW - Previous days audit and presentation	
CLASSROOM ANALYSIS - Individual calculations	CLASSROOM ANALYSIS - Individual calculations				
LUNCH	LUNCH	LUNCH	LUNCH	LUNCH	
PRESENTATIONS + Discussion + Feedback	PRESENTATIONS + Discussion + Feedback	APPOINTING 2 PERSONS TRIAL TEAMS - Persons individual skills - Explain dispatchers phone questionaire and audit team selection process	AUDITS - 5 houses - 2 person trial teams - include presentation to homeowner	COURSE ASSESSMENT And Feedback Presenting Certificates	
PRESENT Recommendations to Homeowner	PRESENT Recommendations to Homeowner				
EVENING	EVENING	EVENING	EVENING	EVENING	

- Homeowners with a greater knowledge of energy conservation than the auditor
- Distractions while in the house

Week 3 consisted of a series of trial energy audits complete with group discussions prior to presentations of results to the homeowners. The audits were initially performed by four-person teams which were reduced to two persons as the week progressed and as more experience was gained by the auditors.

3.5 AUDIT DELIVERY

Formal delivery of residential energy audits commenced after the training course. During the project, 345 residential audits were delivered in Pinawa and 296 in Stonewall. Each audit consisted of five major steps:

1. Scheduling
2. House examination
3. Analysis
4. Report preparation
5. Report presentation

3.5.1 Scheduling - Audit scheduling was the responsibility of dispatchers who operated from the local T.E.A.M. Information Offices. The dispatcher maintained a master schedule on the activities of each audit team. Audit requests, generated by extensive local advertising were received by mail or telephone. A file for each application was created by the dispatcher. Each homeowner was contacted to schedule an acceptable time for the audit. Homeowners were also told approximately how long the audit visit would take. Although most audits were performed during normal working hours, some had to be scheduled for evenings or weekends.

3.5.2 House Examination - House visits were performed by a team of two auditors. Upon arrival at the house they made introductions to the homeowner and briefly explained the nature of the audit:

- What the audit would include
- Which areas of the house they would have to examine
- Approximately how long the audit would take
- When the results would be presented

One auditor then conducted an examination of the house to assess its condition, identify possible opportunities for energy conservation and note any maintenance or safety problems which could affect the recommendations. This activity was structured around the "Existing Conditions" worksheet (see Appendix B) and was designed to document the basic qualitative data on the house. After examining the house, the first auditor interviewed the homeowners to identify their interests and concerns with respect to energy conservation. This was an important part of the audit process since the degree of interest as well as the capabilities (financial and otherwise) of homeowners varied significantly. As much as possible, the audit recommendations were designed with both the house and the homeowner in mind.

The second auditor was responsible for obtaining dimensional data on the house and measuring or estimating the types and amounts of insulation present in each component.

After these steps were completed, the auditors returned to the office to perform the analysis.

3.5.3 Analysis - The objective of the house analysis was to identify the most reasonable, cost-effective conservation measures and to estimate their corresponding energy and dollar savings. The analysis procedures were derived from those described in Ref. 3. which assumed that the heat loss of a house could be described by an equation of the form:

$$\text{Heat loss } \alpha \ \frac{20 \times D \times G}{E}$$

where 20 = The number of hours per day in which the space heating load was met by the furnace

D = The average number of heating degree-days

G = The Overall Heat Loss Coefficient of the house including conduction and air change heat loss

E = The seasonal efficiency of the heating plant.

A series of standardized worksheets were used to calculate energy savings. Retrofit cost data was obtained from the Energy Demo program (Ref. 1) and modified to reflect local prices.

For readers interested in details of the analysis, a short summary of the calculation worksheets is provided in Appendix B. Due to the volume of calculations and writing required, the analysis was performed by the auditors at the T.E.A.M. office. This also provided the opportunity to discuss the case with fellow auditors and supervisory staff.

3.5.4 Report Preparation - Using the results of the analysis, the auditors completed the two page T.E.A.M. Residential Energy Audit Report (see Appendix B). This summarized the recommendations into three categories - no-cost, low-cost and cost-effective measures. No- and low-cost recommendations, such as reducing house temperatures and closing off unused rooms, were preprinted on the report form and checked off as appropriate with no calculation of their anticipated savings or payback.
Cost-effective recommendations were those which required significant cash outlays to implement but were judged to have reasonable paybacks. This category included the addition of insulation to building components, air leakage sealing and furnace upgrading. An individual analysis of the anticipated energy and dollar saving and the simple payback period was performed for each recommendation.

Space was also provided in the report to comment upon other items such as safety or maintenance concerns. In several cases auditors identified safety hazards such as improper storage of flammable liquids, uncovered combustible rigid insulation on basement walls and exposed electrical wiring.

3.5.5 Report Presentation - Presentation of the audit report to the homeowners was performed by an individual auditor who reviewed the recommendations, discussed their significance and noted any other concerns. The auditor also left appropriate conservation literature to provide further information and detail.

3.6 MAJOR RETROFITS

To complement the home energy audits, a demonstration of major energy conservation retrofit measures was included in the Residential Module. Four homes in Stonewall and two in Pinawa were retrofitted during the project. Funding was cost-shared 50/50 between the homeowner and the T.E.A.M. project (after applicable grant contributions had been subtracted) up to the maximum project value of $8,000. A projected saving of 30% of the total annual energy consumption in the home was the chief technical criterion for acceptance into the demonstration subcomponent.

Applications, 14 from Pinawa and 18 from Stonewall, were received from homeowners and ranked for consideration by means of a random draw for each town. Applications were pre-screened and comprehensive energy audits scheduled (in the order of selection from the draw) with the intention of proceeding until a maximum of four homes in each community had been accepted.

Pre-screening by the Consultants, with the aid of the information collected during earlier house visits by the T.E.A.M. energy auditors and with additional site visits in some cases, served to eliminate many of the retrofit proposals. The major reason for rejection was low potential for meeting the program's energy-saving requirements. Many of the homes, for example, were relatively new with insulated, finished basements and new heating systems.

Houses which passed the pre-screening were then subjected to detailed energy audits. These consisted of computer simulations, using the HOTCAN energy analysis program, of the existing house and the proposed retrofit measures, singly and in various combinations. Airtightness tests were also performed from which estimates of natural air change rates were made.

The three of 14 applications from Pinawa in which oil heating was used were found to be the only ones with significant potential for energy savings, primarily through off-oil conversion. The proposed or suggested retrofit packages for these three houses included the furnace conversions and upgrading attic insulation, completing the remaining poorly insulated or uninsulated portions of basement walls, and air leakage sealing. Also included were some less cost-effective measures such as storm windows which could be justified as part of a retrofit package. Although all three houses were found to be in need of very little air leakage sealing for energy-savings purposes, selected sealing was advised as a defence against possible moisture damage resulting from the relatively high interior moisture levels expected after replacement of the oil furnaces with electric heating. One of the three applicants later dropped out of the program and the others proceeded through to the construction stage.

Seven Stonewall homes passed the pre-screening and were subjected to the full energy audits. Airtightness tests were completed on five of these. In two cases the applications were withdrawn when the homeowners decided not to proceed, and in another case, required renovations proved too extensive. Retrofit measures proposed or suggested for the remaining four houses included air leakage sealing and insulation of basement walls. Others included the upgrading of attic insulation, the replacement or upgrading of some windows, and the installation of a high-efficiency natural gas furnace. These four projects proceeded through to the construction stage.

3.7 SEMINARS

A series of homeowner seminars were held in the towns during February, 1984 to provide further information on residential conservation techniques. Two seminars were held in each town. Attendance averaged 20 to 30 people per lecture.

3.8 ADMINISTRATION

Day-to-day administration of the Residential Module was carried out from the T.E.A.M. Information Office in each town. The main administrative task was the establishment and maintenance of a filing system for the house which had been audited. These files contained:

- Audit recommendation forms
- Phone conversation record forms
- Lists of key dates (such as the first contact, date of audit, etc)
- Checklists of literature handed out
- Assessment forms
- Homeowner questionnaires
- Utility releases

Access to the files was carefully controlled to maintain confidentiality.

The only major administration problem encountered was the lack of inventory of some energy conservation literature which was out of stock or being revised.

3.9 OBSERVATIONS AND CONCLUSIONS

3.9.1 General

Most aspects of the Residential Module proceeded as planned although response for audits was somewhat less than had been hoped; 50% of the eligible houses were audited whereas a figure of 80% had been desired. Participation in the major retrofits and the seminars was also somewhat lower than anticipated.

3.9.2 Scheduling - The use of dispatchers, rather than auditors to schedule audits proved extremely valuable. This practice saved time, improved efficiency and allowed audits to be performed in roughly the same order in which applications were received. Further, having one person responsible for scheduling improved record-keeping practices within the office and permitted applications and house files to be handled in a consistent manner.

Since T.E.A.M. was a demonstration project, efforts were made to schedule audit visits to the convenience of the homeowner. Initial site visits were generally performed during normal working hours. Report presentations, however, were usually scheduled for evenings or weekends so the spouse could be present. Fortunately, most auditors accepted this inconvenience as part of the job. However, residential energy audit programs which operate on an on-going basis may experience employee problems if a significant portion of the auditor's work week is outside of normal business hours. In these cases, it may prove desirable for auditors to work a three- or four-day week to permit extra working hours in evenings.

3.9.3 Auditor Hiring - The experiences with T.E.A.M. suggest that the overall calibre of available personnel is surprisingly good, although some effort is needed to identify them. Technical experience and communications skills were determined relatively easily during the interview. It was also noted that the impression created by the initial written application was generally similar to that brought out during the interview. A point of concern however, was the relatively poor (or forgotten) mathematical skills displayed by most students. This should be considered during the hiring process and the training course.

3.9.4 Residential Energy Auditors Training Course - Throughout the T.E.A.M. Residential Energy Auditor's Training Course, written and verbal evaluations were conducted to generate feedback from the students. Based upon these evaluations and the observations of the course instructors, a series of general and specific comments can be made.

The training of residential energy auditors should include a thorough qualitative review of house construction practices and techniques with a special emphasis on local conditions. This should include discussion of all major components of the structure, its mechanical, plumbing and electrical sub-systems and related safety and maintenance issues as well as the effects of occupant lifestyle upon house operation and performance. Energy conservation need not be introduced at this point.

The course should then discuss the qualitative and quantitative considerations of energy conservation techniques including the analysis techniques used to predict the benefits of these measures. The assumptions and limitations of these techniques should be clearly stated so the students develop an appreciation of their accuracy.

A final element of the course should cover written and verbal communications and proper techniques for dealing with the public. All benefit from the audit program is dependent on the ability of the auditors to communicate their findings effectively and efficiently. In retrospect, this phase should have been expanded for T.E.A.M.

The appropriate length of the training is dependent on the scope of the audit service and the backgrounds of the trainees. Based on the T.E.A.M. experience, with a detailed audit program and previously untrained personnel, the appropriate length would be approximately 4 to 5 weeks, with latter portions of the course consisting of some on-the-job training.

Although hand-out material may be supplied to the students during the course, most written information should be contained in the course manual(s). The manual for "Training in Housing Rehabilitation Skills; Course 1 - Inspecting Dwellings and Introduction to Specification Writing" was found to be an excellent document for this first phase introduction. Most parts of the manual "Training in Housing Rehabilitation Skills; Course 3 - Energy Conservation in Rehabilitation" were considered to be very well suited to the second phase of the training. However the sections dealing with analysis techniques were not considered to be suitable for large-scale audit delivery programs, although still useful as learning aids.

Judging from the course evaluations, students felt that most presentations were at an acceptable technical level, neither too simplistic nor too complex. One exception was that too much material was presented in too short a time span, particularly in those sections dealing with the analysis procedures. Most students felt that more time would have been warranted for both the classroom presentation of the material and the opportunities to perform worked examples - particularly in group settings.

Specific comments and recommendations received from the students included:

- Improve summaries at the end of each lecture - Students were occasionally unsure what the main points in the lecture were vis-a-vis their role as energy auditors, and would have benefited from encapsulated summaries in the last 5 to 10 minutes of each lecture.
- Increase emphasis on communications - A minimum of two days should have been assigned to communications although more would be desirable.
- Shorter lectures - Students (and instructors) were often fatigued by excessively long lectures, 1½ hours should be the maximum period between breaks.
- More time for group discussions, especially in small groups - This would have allowed the student to become conversationally proficient with the subject matter, an obvious need for an energy auditor.
- Better organization and presentation of the course schedule so that student's personnel activities can be adjusted accordingly - The volume of homework in the auditor's course may have been more than was initially expected by the auditor and his family.
- Revise calculations procedures - These were too complex in some areas (e.g. calculating the thermal bridging effects of studs and joists) and too general in others (e.g. basement heat loss procedures).
- Introduce additional slides of local examples, conditions and installations - With a regionally delivered program, it is preferable to focus on specific local situations.
- Have more material samples, models, mock-ups, products, failed components, etc. present in the classroom - This would be superior to simple slides or line drawings.
- Simplify cost/benefit analysis - There should have been more discussion of simple payback periods while more sophisticated analysis procedures could be omitted.

- Discuss "standardized" responses to questions which exceeded the energy auditors' training - Standardized responses would allow the auditors to extricate themselves from difficult questions or situations.
- Offer students better explanations for differences between manuals and lectures on some technical issues.
- More emphasis on specific energy conservation recommendations rather than general discussions.
- Introduce some discussion of energy conservation practices in new construction - This is required to give the auditors a more balanced view and to allow them to answer questions received from homeowners. A suitable textbook might be "Energy-Efficient Housing Construction" by CMHC (NHA 5488 82/11).
- Add more direction to site visits - Improvements could have included better explanations of what was required, improved guidance by the instructors to point out significant features within the house, more group discussions in the house, extra time to re-examine the structure after the group discussion to note items missed, and, if possible, more time for the visit. Having slides of the case-study houses during the follow-up presentations would have been an asset.
- Revise house assessment forms to streamline their use and focus on the objective - The assessment forms were too long and unwieldy for efficient delivery of energy audits.
- More defined methodology for performing the energy audit - Better step-by-step procedure would have been desirable, at least until the students could develop procedures best suited to themselves.

3.9.5 Post-Course Support Services - At the completion of the course, auditors can be regarded as trained but not qualified for their roles and thus need further support. The entire audit program must have a structure which provides this support in an on-going and consistent manner.

3.9.6 Number of Visits Per Audit - Under routine conditions, performing two house visits per audit, as was done in T.E.A.M., would be time-consuming and expensive. The second visit could add 25% to 75% to the total cost of the audit. During T.E.A.M. this was not considered a major problem for two reasons. First, the geographic areas in which the project was delivered were quite small so travel time and costs were minimized. Second the T.E.A.M. auditors, like any newly trained employees, were not totally proficient in their roles at the completion of the training course. Affording them the opportunity to discuss each house and their proposed recommendations with peers and supervisory staff in a familiar environment was part of the training process. For other audit programs of longer duration, use of two-visit systems for new auditors for the first few weeks should be considered. The system would also be useful when a very complex or difficult house is encountered.

3.9.7 Analysis Procedures - The analysis procedures and forms used to perform the energy audit served their intended purpose despite their excessive length and limited accuracy. Unfortunately, further development of the procedures was hindered by the delivery schedule of the T.E.A.M. program. Since T.E.A.M. was intended as a short-term, once-only project, these limitations were not considered serious.

As previously described, the analysis procedures were a refined version of those used in Ref. 3. They assumed that the heat loss from a home could be described by an equation of the form:

$$\text{Heat Loss} \propto \frac{20 \times D \times G}{E}$$

where 20 = The number of hours per day in which the space heating load was met by the furnace

D = The average number of heating degree-days

G = The Overall Heat Loss Coefficient of the house including conduction and air change heat loss

E = The seasonal efficiency of the heating plant.

While computationally simple, this method represented a very basic description of the complex phenomenon of heat loss from a house.

The term "20" conceptually may be described as the average number of hours per day in which the heating load was met by the furnace. However this term is actually a variable since its value is a function of "G" and the manner in which the house is operated. Also, the value of 20 is high for most Manitoba houses. Other experiences have indicated that appropriate values would be in the range of 14 to 20 and sometimes lower. The use of a high value results in overpredictions of both the space heating load and the energy savings attainable from retrofitting.

Although a formal analysis of predicted and measured space heating loads was not performed, casual comparisons with fuel bills (which were occasionally available) suggested that the analysis procedures used in T.E.A.M. tended to overpredict loads and possible savings.

Other limitations of the analysis procedures and worksheets were identified. The most significant of these was that the long, often repetitious computation placed a disproportionate emphasis on relatively minor concerns while ignoring major inaccuracies. The nomograph used to estimate air change rates (see Appendix B) was found to produce questionable results and was ultimately replaced with data taken from Ref. 4.

In retrospect, the analysis procedures served their intended function. For an audit program with an on-going delivery period, they, or similar ones, would be very useful as a training aid. Once a proper understanding and appreciation of the calculations was acquired, a more streamlined procedure could be used.

3.9.8 Energy Audit Computerization - The possibilities offered by computerization of the audit process are obvious; freedom from tedious calculations, reduced possibilities of errors, less paperwork, etc. Due to the relatively short life of the T.E.A.M. project, non-computerized energy audits were used. Should computerization of an audit program be considered, the following concerns should be addressed.

- o Reliability of the equipment and its software in the field - During the review of other residential energy audit programs concerns were raised about the survivability of the equipment in the field. Hardware and software problems were both noted. In these cases the auditor's centre of attention could become the machine and not the house and its occupants.

- The image of a "computerized" energy audit - The "computer" still has a mystique in some homeowners' eyes and for that reason could leave a false impression of the accuracy of the audit. Skepticism in other cases could result in dismissal of the recommendations simply because they were produced by a machine.
- The need for the auditors to understand the details of the calculation procedures and to recognize their limitations - Working through calculations by hand gives the auditors a good grasp of the significant factors as well as more respect for the non-quantifiable aspects of the audit. Even if computerization were used, the auditors should still learn the details of the procedures and not be introduced to the machine until they become conversant with the hand calculations.
- Increased training time - Most potential auditors, including those hired for T.E.A.M. have limited or non-existent experience with computers. Considerable time (perhaps one to two weeks?) would have to be added to the training course to address this need.

The above notwithstanding, a properly designed, tested and controlled, computerized package does have a role to play in residential energy auditing and should be actively pursued.

3.9.9 Energy Audit Recommendations - The experiences of the T.E.A.M. project offered several insights into what the average homeowner desired from an energy audit. For example, they indicated that the qualitative rather than quantitative recommendations were the most valuable benefits from the homeowners' perspective. The ability of the audit to identify "which" measures to undertake, "what" their priority should be, "how" they should be carried out, etc., were the most important. The rigorous analytical treatment which produced estimates of energy savings, payback periods, etc., although contributing to the qualitative results, was not of significant interest to most homeowners.

Perhaps the greatest benefit of the audit was that of advising homeowners what NOT to do rather than what to do. Despite the high visibility of energy conservation and extensive public education programs, homeowners often displayed a very poor appreciation of the most cost-effective ways to save energy. Window and door replacements, for example, were seen by many as priority items, even though the existing units were often in reasonable condition. On the other hand, relatively cost-effective opportunities to save energy, such as upgrading insulation levels of poorly insulated components, air leakage sealing and replacing older heating plants with more efficient units, were often overlooked by the homeowner. To some extent this may have been caused by homeowners attempting to justify actions which they wanted to take for other reasons (such as replacing windows for aesthetic reasons).

A critical requirement for a successful audit was found to be the need for extensive interaction between the auditor and the homeowner. This was required both to transmit advice and to convince the homeowner of the benefits of implementing the recommendations.

Energy auditors should ideally be trained to deal with retrofits ranging from the relatively simple to the extremely sophisticated. Realistically, the auditor is unlikely to encounter large numbers of major conservation retrofits. In fact, based on the T.E.A.M. experiences, most recommendations can be grouped into one of the following two classes:

1. No-cost and low-cost options - Recognizing the economic climate, the lack of disposable income and general economic uncertainty, most homeowners were unwilling to make major cash outlays simply to save energy, even if a cost analysis suggested such investments were justified. In many cases, the amount of money they were willing to commit consisted of applicable grant monies plus some personal funds. Identifying work which is within the scope of grant monies would be of major value to the homeowner.

2. Future replacement options - The possibilities for items which were still functional but approaching the end of their useful lives needed to be brought to the attention of the homeowner so that as replacement became necessary, more energy efficient options could be considered. Items in this category include heating plant replacements, re-siding and window/door replacements.

The foregoing also suggests that major energy audit programs should be preceded or accompanied by a market survey of eligible homeowners and houses so that auditor training, audit procedures and various management considerations could be focused to address the needs of the eventual users.

Finally, it is desirable that recommendations be standardized through use of reference paragraphs and phrases when the homeowner report is prepared. This will improve consistency between audits, reduce errors and save time.

SECTION 4
MUNICIPAL MODULE

4.1 OBJECTIVES AND SCOPE

The Municipal Module was designed to extend the project to municipally owned buildings and facilities within each town. This module was undertaken for two reasons. First, since municipal buildings and facilities fall under the jurisdiction of the local authorities, the initiative would have to come from them for any savings to result. Municipal buildings are large energy consumers, making them good candidates for energy conservation. Second, extending the T.E.A.M. competition to the municipal level would hopefully stimulate enthusiasm within the other modules due to the public exposure.

To investigate the potential for conservation within the municipal sector, the following program was developed. Five municipally funded buildings in each town were selected by the respective towns and the T.E.A.M. Project Management Committee. The Consultants analyzed these buildings and provided an energy report on each facility. The reports indicated the buildings' present energy utilization characteristics and identified numerous Energy Conservation Techniques (ECT's). After the studies were completed, facilities from each town were selected for an energy conservation retrofit costing up to $40,000. Selection was made by each town's Steering Committee with the approval of the T.E.A.M. Management Committee. The implementation costs were shared 50/50 between the towns and the T.E.A.M. project. The Consultants provided the engineering design, contract administration, and required inspection services. They also provided each town with a general report, outlining typical energy conservation techniques applicable to municipal facilities and services.

4.2 ENERGY AUDITS

The only restriction imposed on the selection of the facilities to be retrofitted was that the structures had to be receiving some form of funding by the municipality.

Based on this selection process the following buildings were selected for energy audits:

Pinawa

- Community Centre & School
- Administration Building
- Water Treatment Plant
- Golf & Curling Club
- Arena

Stonewall

- Stonewall & District Health Centre
- Bobby Bend School
- Community Curling Club
- Crocus Manor Retirement Home
- Firehall

It should be noted that only six buildings in Pinawa met the selection criterion.

After the facilities were selected, each underwent an energy audit to determine the extent of potential energy conservation and identify ECT's. The energy audit included examinations of:

- Energy records
- Structure use and occupancy
- Mechanical systems (heating, ventilation and air conditioning)
- Electrical systems
- Building envelopes
- Maintenance procedures

In general, ECT's were considered acceptable if they provided a simple payback period of five years or less. A summary of the predicted savings is shown in Figure 4.1.

The recommendations and corresponding savings were strongly affected by the available energy sources in each town. Stonewall was connected to the natural gas grid and most facilities used gas for heating purposes.

FIGURE 4.1

PREDICTED SAVINGS IN MUNICIPAL BUILDINGS AND FACILITIES[1]

	Annual Energy Savings	Annual Cost Savings
Pinawa		
Community Centre & School	23%	29%
Administration Building	36	37
Water Treatment Plant	10	9
Golf & Curling Club	20	15
Arena	11	17
Stonewall		
Stonewall & Distric Health Centre	22%	14%
Bobby Bend School	27	15
Community Curling Club	35	27
Crocus Manor Retirement Home	3	26
Firehall	23	25

Notes:

1. Obtainable from Energy Conservation Techniques with simple payback periods of five years or less.

Pinawa was not connected to the gas grid and thus most facilities used oil (which was more expensive than gas) or, in a few cases, electricity for space heating.

Although each type of facility tended to possess its own unique opportunities for energy conservation, the most commonly recommended ECT's were:

- o Modifications to maintenance procedures
- o Night setback of space temperatures
- o Air infiltration reduction

These three ECT's were generally applicable to most of the facilities, regardless of type. Other ECT's which were recommended included: ventilation system control, power factor correction, locking thermostat cases, exhaust air heat recovery systems, boiler servicing, and delamping.

Both towns indicated the intention to implement most of the energy conservation techniques specified in the audit reports. Based on this premise, the projected saving in the municipal sector of Pinawa would be 4.7×10^6 kWh or 19% of its original consumption. Stonewall would save 2.2×10^6 kWh, or 15%.

4.3 RETROFITS

Following the audits, the Town Councils were advised which facilities were good candidates for retrofit. In Pinawa, the site selected was the Community Centre and School since the retrofit cost was tendered to be $36,773 with a reasonable payback. In Stonewall, the selection was a process of elimination. The School and Curling Club had received energy audits from previous energy conservation programs and the resulting recommendations were in the process of being implemented. The Firehall was scheduled for demolition and the Retirement Home would not have benefited from a major retrofit. Consequently, the Health Centre was chosen. Cost of the retrofit was valued at $23,400. This was reduced to $9,815 after a glycol run-around heat recovery system was eliminated because it conflicted with another project initiated during the retrofit tender period. Due to the difference in retrofit costs between the two towns, funding was provided to assist with a retrofit to the Stonewall Community Curling Club. However the savings estimates discussed below are for the Health Centre only.

These two facilities represented the best selection that could be made under the circumstances. It would have been preferable to select facilities needing retrofits of equal value but this proved to be impossible.

The Pinawa retrofit consisted of the following energy conservation measures:

- The calibration of an existing fan control board. All controls were operated manually, but the control board had not been calibrated.
- The installation of an off-peak electric boiler. During unoccupied periods, when the school lighting levels were reduced, the electric boiler would assist the existing oil boilers in heating the building. Heating with electricity was cheaper than with oil provided the electric boiler was controlled so that the electrical demand limit was not exceeded.
- The room thermostats were replaced with night setback thermostats. This allowed the Community Centre & School to be operated with lowered space temperatures during unoccupied periods. Savings occurred from reduced heat losses. The thermostats could be overridden if necessary.

The Stonewall retrofit consisted of the following energy conservation measures:

- The installation of tamper-proof thermostat covers to prevent overheating in the lounge area of the Centre.
- The installation of a time clock for the dental wing exhaust fan to shut off the fan when the wing was unoccupied.
- The insulation of a steam/water heating convertor. The original convertor had been replaced with an uninsulated unit, causing high heat loss.
- The installation of a piping loop between the new and old boilers of the hospital. The piping loop allowed the old, inefficient boiler to be shut off. The newer boiler could supply both loads

with the old boiler available as a back-up. Savings resulted from an increased system efficiency.

The actual savings which will result from these retrofits were predicted to be as shown below. Note that the savings are less than shown in Figure 4.1 due to the deletion of some ECT's:

	Annual Energy Savings	Annual Operating Costs Savings
Pinawa Community Centre & School	11%	11%
Stonewall and District Health Centre	7%	5%

4.4 DISCUSSION

The Municipal Module proved to be successful in terms of increasing conservation awareness and the application of conservation techniques. The requirement of energy conservation at the municipal level was reflected in the attitudes of the Town Councils. Enthusiasm originally shown by the municipalities at the beginning of the competition remained strong throughout the program. The support offered by T.E.A.M. provided the necessary stimulus to the towns to proceed with energy conservation. A ripple effect from the municipal level to the residential, commercial and industrial sectors may follow.

Building operators were in general agreement with the use of a simple payback period of five years as a criterion for action. However this opinion was not based on formal financial analysis but rather represented a general perception of what constituted a "worthwhile" investment. For example, none of the operators displayed any interest in a life cycle cost analysis of the options. Decisions were also influenced by the availability of grant monies. The attitude displayed by many operators was that any measure for which outside funding could be obtained was worth implementing regardless of its cost-effectiveness.

Building operators usually displayed a good understanding of the technical aspects of energy conservation. In several cases, they had researched the subject in considerable detail prior to the T.E.A.M. project and were quite familiar with the various ECT's. In a few instances, the operators had even obtained price quotations on various alternatives which they had identified. Therefore the energy audits seldom provided them with a great deal of new technical information. However, the benefits of the audits appeared to be:

- Confirmation of Alternatives - Although most operators had a good understanding of the technical issues they were often unsure of their own knowledge and appreciated the opportunity to receive confirmation from an outside authority. Until this confirmation was received, several were unwilling to suggest their ideas to management.
- Economic Priorization of Alternatives - Most operators had a poor grasp of the savings which various ECT's would produce due to a lack of analytical capabilities on their part. Their estimates of energy savings often appeared to be based upon general information extracted from popular magazines and trade journals. As a result, they were unable to priorize the alternatives on the basis of their paybacks. An ECT with a simple payback of 3 years might have been viewed as favourably as one with a payback of 15 years. Considering the limited funds which most municipalities have available, this could represent a major obstacle to implementation of cost-effective conservation measures.
- Credibility of Recommendations - Recommendations for implementation of energy conservation measures were more favourably received by the municipal boards when the recommendations came from, or were supported by, an outside authority. Recommendations from the building operators, regardless of their technical and economic validity, were less likely to be supported. The building operators were often aware of this and used the energy audit as a vehicle to promote their ideas.

The method of analyzing the two towns proved adequate. If other competitions are organized, all municipal buildings could be audited. In this way, the towns would have a complete review of the municipal energy consumption and possible savings. Based on the attitudes of the two towns, most energy items identified may be expected to have a good chance of eventually being implemented.

4.5 OBSERVATIONS AND CONCLUSIONS

- Audits of the municipal facilities were well received and appeared useful in encouraging implementation of energy conservation measures.
- Building operators displayed a good understanding of the technical aspects of energy conservation but still welcomed the opportunity to discuss and confirm their beliefs with an outside authority.
- Perhaps the most valuable aspect of the audit was the prediction, with accuracy and confidence, of the anticipated savings of each conservation measure, thus permitting a priorization of options on the basis of their payback periods.
- The fact that the energy audits were performed by a party external to their organizations appeared to improve the acceptance of the audit recommendations by the municipal boards responsible for operation of the facilities.
- The methods of economic analysis and comparison preferred by the building operators and the towns were relatively basic and did not include life cycle cost analysis.
- The ability of the municipalities to implement cost-effective recommendations was restricted by their access to the required funding.

SECTION 5
TRANSPORTATION MODULE

5.1 OBJECTIVES AND SCOPE

Transportation accounts for a significant portion of society's total energy usage. Although consumption is difficult to pattern within small geographic areas (such as those used for T.E.A.M.), there is a strong incentive to implement measures to reduce transportation energy usage.

The Transportation Module of T.E.A.M. was stuctured around Fuel Economy Diagnostic Clinics held in each town. This offered residents the opportunity to have a diagnosis performed on their vehicles at no cost.

5.2 DESCRIPTION

The clinics were operated by Hampton Enterprises of Pinawa and Gulf South Side Service of Stonewall, under contract to the Consultants. These contractors were selected by a tender process open to service station owners in both towns.

Residents of the towns were notified of the clinics through information packages mailed to each household. Appointments were booked in advance using numbered, transferable cards enclosed with the mail-outs.

The clinic analysis consisted of an evaluation of engine performance using a Sun Micro II analyzer. Performance of the ignition and fuel systems was determined and minor adjustments were made to the engine timing and air/fuel mixture wherever possible. Tire pressures were also checked and adjusted as necessary. Copies of the Engine Performance Test Report and the Diagnostic Report are attached in Appendix C. The vehicle owners were also issued a written evaluation outlining problems requiring more extensive repairs. Included with the evaluation was a reply form for documenting corrective action taken as a result of the clinic recommendation. Processing of each vehicle required approximately 30 minutes.

The programs commenced the second week of January, 1984 and operated for approximately fifteen weeks. Of 715 mail-outs sent to each town, 453 vehicles were processed in Pinawa and 425 in Stonewall. The Pinawa figure includes 36 AECL company vehicles.

5.3 OBSERVATIONS AND CONCLUSIONS

- General response to the Fuel Economy Diagnostic Clinics was enthusiastic and only two customer complaints were registered. In retrospect, the clinics also provided excellent public relations for the T.E.A.M. project and appeared to reinforce a positive attitude towards conservation in general. Future multi-sector conservation programs could benefit from an expanded Transportation Module - because of the direct savings and the enthusiasm and interest which they generate. It may also be beneficial to schedule the clinics early in the program as a means of promoting the entire project.

- Based on observations by the Consultants and supported by discussions with the contractors, vehicle owners appeared quite willing to accept the clinic results and did not display any concern that they were performed by commerical operators who might benefit from repair work which was identified during the analysis.

- Although formal records were not maintained, casual observations and discussions with the clinic mechanics suggested that most vehicles processed by the clinics were operating in a reasonably efficient manner. More extensive work to improve efficiency was required on approximately 20% of the vehicles.

- Formal estimates of anticipated fuel savings were not prepared. However a subjective review by the Consultants suggested that average savings for all the vehicles processed would be in the order of 5%.

- If large-scale fuel economy clinics were considered it would be worthwhile to obtain better estimates of the savings resulting from them. This could involve a rigorous determination of pre- and post-clinic mileage on a representative sample of vehicles. This would permit a more accurate determinaton of the cost effectiveness of the clinics. Since the annual energy cost for the family car is approximately the same as for the house, the opportunity to save energy and money is tremendous.

- To reduce the cost of future fuel economy clinics, it might prove advantageous to combine them with other, established programs such as the motor vehicle safety inspection programs. The marginal cost of the clinic could thus be held to a minimum and the convenience to the public maximized. Further this might reduce the irritation many owners experience when they are forced to bring their vehicles in for safety inspections. Although more detailed study would be required, it is recommended that this concept be considered for delivery of future fuel economy clinics.

SECTION 6
INDUSTRIAL/COMMERICAL/INSTITUTIONAL (I/C/I) MODULE

6.1 OBJECTIVES

The objective of the I/C/I module was to extend the T.E.A.M. project into the industrial, commerical and institutional sectors of the communities. (Institutional buildings were classified as all those public buildings that were not included in the Municipal Module).

6.2 DESCRIPTION

Forms to request energy audits were distributed to all eligible facilities in the towns along with information about the potential value of the audit in leading to a reduction in energy costs. Audits were scheduled to be performed by the "Energy Bus" run by Manitoba Energy and Mines. The bus audit provided a computerized print-out of the energy utilization in the facility and also made recommendations to reduce the energy consumption.

Similar to the Municipal Module, the most frequently recommended energy conservation measures were:

- Modifications to maintenance and operating procedures
- Night setback of space temperatures
- Air infiltration reduction

Other recommended measures depended on the relative size of the structure being audited. Smaller buildings sometimes required additional insulation to be applied or heating systems to be tuned. Larger facilities, with more complex mechanical and electrical systems received such recommendations as: modifications to the ventilation control system, power factor correction, delamping and computer-operated control systems.

In Pinawa, 12 out of a possible 16 establishments received audits. In Stonewall, the Energy Bus received 30 requests for audits out of the 90 eligible buildings. Many of the private businesses were conducted in residential dwellings; therefore, members of this group were included in the Residential Module.

At the end of the competition year, questionnaires were sent to all audited facilities. The questionnaires indicated which of the energy conservation measures recommended as a result of the Energy Bus analysis had been implemented.

Questionnaires were answered by all applicants at the completion of the program. The 100% reply which was achieved was due to the coordinated effort of local administrators.

6.3 OBSERVATIONS AND CONCLUSIONS

- In general, Pinawa was more successful than Stonewall at implementing actions recommended by the audits. This outcome was largely caused by differences between the I/C/I sectors in the two towns. Since the success was based on the energy saved, the size of the building had a great effect on the economical energy savings. A limited amount of energy consumption limits the number of energy conservation techniques to no- and low-cost retrofits. Consequently Stonewall was at a disadvantage when comparing its I/C/I buildings to that of Pinawa, because the buildings in Pinawa presented opportunities for more cost-effective measures.

- The program was also more effective in Pinawa due to the relative number of businesses. Population-wise, Stonewall and Pinawa are equal, but business-wise they are quite dissimilar. Stonewall, having a large number of businesses, required more effort to make the program as successful as it was in Pinawa. Whether or not the two towns received the same level of encouragement is unknown.

SECTION 7

STATISTICAL BASE MODULE

7.1 OBJECTIVES AND SCOPE

The Statistical Base Module had two primary and interrelated objectives:

1. To assemble energy use statistics on the towns to permit estimation of the energy savings produced by the other modules.
2. To administer the competition-related aspects of the T.E.A.M. program and to identify the winning town.

The first objective was achieved by cataloguing the buildings and facilities in each town in the pre-audit state and estimating the energy consumption for each. Actual energy consumption was not readily available, thus estimated data, based on input from the other modules in the project, was used.

The second objective was met by formulating a procedure acceptable to both towns for scoring the T.E.A.M. competition. This evolved into the "T.E.A.M. Competition Guidelines" (see Appendix D) which was used to award points based on energy conservation activities and actions. Using the Competition Guidelines, the winning town was selected.

The balance of this section describes how these objectives were met and also offers some observations and comments on the competition aspects of the T.E.A.M. project.

7.2 CATALOGING OF BUILDINGS AND FACILITIES AND THEIR GROSS ENERGY USAGE

Lists of buildings and facilities were assembled using Provincial Assessment Rolls for both towns. The businesses resident in each building listed on the Rolls were checked to verify that they were actually occupying the space. It was found, paticularly in Stonewall, that businesses tended to relocate frequently. Many businesses operated from homes, and these were catalogued as residential buildings. Thus, an updated list of non-residential structures had to be compiled.

Local T.E.A.M. Information Office staff in both towns were used to check this data. They also took responsibility for updating the lists of buildings because they were familiar with the activities of firms which had moved, expanded, or gone out of business. They also were able to identify where new houses had been built and who their occupants were.

Collection of the energy use data proved to be difficult and time-consuming. Businesses in Stonewall primarily used natural gas heating and gas consumption data would only be released by the utility with a signed release from the building owner. The utility was also unable to provide a computer listing of previous gas consumption. As a result, a T.E.A.M. staff member had to copy the data manually from utility company records. Electrical consumption data was available in the form of a computerized listing from Manitoba Hydro once a release was obtained. Obtaining records from fuel oil suppliers was also difficult since their records were not organized for easy retrieval of such information. Finally, many homes used wood heaters. Detailed estimates for this energy source were not thought to merit the considerable time and effort that would have been required to prepare them.

It had originally been intended to issue monthly energy use reports on both towns. However it soon became clear that this was unworkable for a number of reasons:

- Energy data sources were poor
- There was no submetering at the town level
- Retrofit work would not be completed until the end of the project so there would be minimal change in consumption patterns until the end of the competition year
- The competition year was based on the calendar year not on a heating season. Thus, most of the actual savings would not be fully recorded until the 1985/86 heating season

Although work was expended in designing a monthly energy reporting and management system, the requirement for this component was dropped.

Eventually, estimates of residential energy use were produced using knowledge which had been obtained during the audits of housing stock. Actual consumption data for the Municipal and Industrial/Commercial/Institutional Modules were obtained from the Consultant's and Energy Bus's audits. A projection of non-residential consumption for both towns was then produced and used in the energy savings competition. No attempt was made to collect data on transport energy because of the scale of the task.

Consideration was also given to computerizing all records. It became clear that the cost for computerizing the required 1500-2000 records for both towns would be prohibitive. The only advantage to computerization was that it would have permitted merging of different data sources (e.g. assessment data and energy data) to make comparisons of subgroups of buildings (e.g. buildings built before a certain date).

7.3 COMPETITION GUIDELINES

An intent of T.E.A.M. was to engender friendly competition between the towns to encourage participation and save energy. The original phrase used in the request for proposal was "Competition Energy Use Guidelines" since it had been hoped to produce performance targets such as energy saved per capita. However, it became clear that measuring energy savings was only one aspect of the competition and that other factors would also have to be considered. Another concern in the design of the competition was the need to ensure that both towns perceived it to be fair.

Pinawa and Stonewall are quite dissimilar towns even though their populations are approximately equal. Pinawa is a town founded in the 1960's to serve as a base of AECL's nuclear research activities. Stonewall is a rural centre, with many of the townspeople working in Winnipeg. The variations in age and type of structures in Stonewall are much greater than in Pinawa. The energy consumption estimates for both towns indicate that Pinawa initially used half the energy of Stonewall.

The proposed guidelines had three major components within which points were to be awarded. Component 1 emphasized participation by both towns in the energy audits, the Fuel Economy Diagnostic Clinics and other activities. Component 2, awarded points for actions taken to save energy.

Points in Component 3 were awarded on the basis of energy saved. Thus a homeowner or business received points in Component 1 for having an energy audit performed, points in Component 2 for taking some initiative to act upon the recommendations of the audit (e.g. insulate the basement), and points in Component 3 in recognition of actual energy saved.

The Competition Guidelines allocated a maximum of 100,000 points to each town for the three components. The points were distributed as follows:

	Points
Component 1 - Heightening Awareness/Participation	20,000
Component 2 - Recognition of Action Taken	50,000
Component 3 - Measurement of Energy Saved	30,000
TOTAL	100,000

Emphasis was placed on Component 2 - Recognition of Action Taken. If conservation measures were implemented, such actions could be expected to save energy. However, given the difficulties of measuring savings and the fact that most savings would not be fully realized until the next heating season, emphasis was placed on the actions rather than on the eventual results (the energy saved).

There were two other factors critical to the design and acceptance of the Guidelines. The first was that all parties, both towns and the T.E.A.M. Steering Committee, had to agree in writing to the Competition Guidelines. Secondly, the awarding of points had to be done by an unbiased group of Judges - selected to be the Consultants. While no problems were anticipated, and none occurred, these two rules ensured fairness and minimized disputes.

Data for the Residential, Municipal and the Industrial/Commerical/Institutional Modules were collected by T.E.A.M. audit staff originally hired as dispatchers when the T.E.A.M. Information Offices were opened. A Procedures Manual was prepared which summarized the necessary instructions for awarding points.

Collection of the residential points data proved to be a major task.

A sample of houses was first identified in each town. Householders were contacted by phone to review their audit recommendations. The staff member asked which recommendations had been followed, and points were awarded based upon the householder's response in the three categories of recommendations, namely:

- No-cost recommendations (e.g. turning down thermostats)
- Low-cost recommendations (recommendations under $100 such as timers on car plugs)
- Cost-effective recommendations (defined as those recommendations with a simple payback under 5 years, such as insulating attics and basements)

No attempt was made to weight the recommendations on the basis of energy saved. Rather, points were awarded on the basis of the percentage of recommended actions that were followed. Points were also awarded if homeowners undertook work which was not recommended, such as replacing windows. Generally, people did not perform work which had not been recommended.

7.4 FINAL POINTS STANDINGS

The competition year ran from January 1, 1984 to December 31, 1984. At the completion of the competition year, the final points standings were tabulated. These are summarized in Figure 7.1. A more detailed description is provided in Appendix D.

A number of comments can be made about the results of the points totals.

- Although Pinawa outscored Stonewall by a healthy margin and won virtually every category, both towns received less than half the total points available. The major shortfall came in Component 2. A possible explanation was that no money and little effort were required to obtain points in Component 1, whereas money and time needed to be committed to obtain points in Component 2.

FIGURE 7.1

SUMMARY OF POINTS AWARDED

	Pinawa	Stonewall	Total Available Points Per Town
COMPONENT 1: HEIGHTENING CONSERVATION AWARENESS			
1.1 Residential Module	3,086	2,073	5,000
1.2 Industrial/Commerical/ Institutional Module	2,923	1,857	3,000
1.3 Transportation Module	3,171	2,975	5,000
1.4 Municipal Module	0	0	0
1.5 Attendance at Seminars	160	375	2,000
1.6 School Poster/Essay Contest			
Spring Contest	1,000	844	1,000
Fall Contest	824	1,000	1,000
1.7 Special Contest Module	1,200	150	3,000
COMPONENT 1 TOTAL	12,364	9,274	20,000
COMPONENT 2: RECOGNITION OF ACTION TO SAVE ENERGY			
2.1 Residential Module	13,995	7,329	30,000
2.2 Industrial/Commercial Institutional Module	1,538	119	15,000
2.3 Municipal Module	953	777	5,000
COMPONENT 2 TOTAL	16,486	8,225	50,000
COMPONENT 3: MEASUREMENT OF ENERGY SAVINGS COMPONENTS TOTAL	10,120	6,640	30,000
TOTAL POINTS AWARDED	38,970	24,139	100,000

- The most successful subcomponent of Component 1 was the school poster/essay contest. Only one such contest was originally included. Given the popularity of this contest, an additional one was held. The ceiling of 200 posters/essays was exceeded. This response suggested the importance of involving young people in energy conservation.

- There was little interest in seminars. One possible reason was that those who requested an audit or who had visted a T.E.A.M. Information Office received the desired information.

- While both towns received less than half the points in Component 2 of the Residential module, the work done by those who received audit recommendations was encouraging. When one considers only those houses for which audits were performed, Pinawa received 13,995 out of 18,630 points, or 75% and Stonewall received 7,329 out of 12,432 points, or 59%.

- Although no surveys of unaudited houses were carried out, casual observation suggested that homeowners who had their houses audited were more likely to implement energy conservation measures than homeowners who did not request an audit. While a portion of these measures would have probably been performed by some homeowners regardless, it is reasonable to conclude that the audit served as a motivating factor to encourage action.

- A review was carried out of the points distribution in the Residential Module to attempt to identify any patterns that would aid in selecting a sample of houses so that savings for the audited houses could be estimated. In general, homeowners were found to have acted upon some of the recommendations, both no- and low-cost and cost-effective measures. It is interesting to note however, that some homeowners who did little or none of the no- and low-cost work implemented some cost-effective measures. There was also a minority of homeowners who performed most or all of the no- and low-cost but none of the cost-effective recommendations. Further efforts would be necessary to determine the impact of a residential audit upon homeowner motivation.

- Given that less than half of the 3000 points in the Special Contests module were awarded, participation in this module was less than expected. Other than the production of a school play in Pinawa and a poem in Stonewall, little of an innovative nature was done by the towns.

- Participation by business in Component 2 was minimal. Despite the fact that other funding was available to business, the conservation involvement by the towns was limited to conservation measures using the 50/50 funding for such work available under T.E.A.M.

7.5 ESTIMATED ENERGY SAVINGS

The pre-T.E.A.M. energy consumption patterns for the towns as well as the savings which T.E.A.M. will produce can only be roughly estimated because of the numerous assumptions which had to be made to produce the energy use data base. Therefore caution should be exercised when considering these results. Acknowledging these limitations a summary of the estimated annual energy consumption and the energy savings produced by T.E.A.M., exclusive of the Transportation Module, is shown in Figure 7.2. Estimates for the Transportation Module were excluded from the summary because of the absence of both energy use data and any calculated predictions of energy savings. Using an energy cost of 3¢/kWh, (which, in 1984, was approximately equal to the residential electrical run-off rate and the net residential natural gas run-off rate using a furnace efficiency of 60%) the value of the estimated annual energy saved in the two towns was approximately $170,000.

7.6 DISPATCHER DEBRIEFINGS

Since the dispatchers had established numerous formal and informal contacts with residents of the towns in the course of collecting data for the final point standings, a debriefing session was held with them to document some of their observations. These are noted below:

- People were generally surprised to learn of the no/low-cost savings that were possible. They were also surprised to learn that such measures as window retrofits were not cost effective. For example, those who had night setback thermostats installed appreciated the advantages.
- T.E.A.M. was 5-10 years too late. People in Pinawa generally saw themselves as having a fair knowledge of energy conservation. Pinawa also expected and wanted a more "scientific" audit, i.e. using airtightness testing equipment, air quality monitoring, etc.
- About one quarter of the safety hazards found by the auditors were corrected by the homeowner (e.g. exposed beadboard insulation in basements).

FIGURE 7.2

ESTIMATED ANNUAL ENERGY CONSUMPTION AND SAVINGS

(EXCLUSIVE OF TRANSPORTATION MODULE)

	Pinawa		Stonewall	
	Estimated Annual Energy Consumption[1]	Estimated Annual Energy Savings[1]	Estimated Annual Energy Consumption[1]	Estimated Annual Energy Savings[1]
Residential Module	7.2	0.3	21.7	1.1
Municipal Module	4.7	0.9	14.3	2.2
I/C/I Module	11.0	1.1	15.7	0.1
Total	23.0	2.3	51.7	3.4
Estimated Savings	10%		7%	

Note:

1. In units of millions of kilowatt-hours equivalent.

- In Pinawa there appeared to be annual conservation "trends". The previous year it had been roof turbine-type ventilators and during the competition year it was window upgrading. In contrast, there was little sign of these trends in Stonewall. About 10% performed window retrofits in Pinawa that were not recommended. There were few such cases in Stonewall.

- Program timing was a problem in Stonewall. A tax audit conducted immediately prior to T.E.A.M. by another provincial government department stopped people from performing conservation retrofits. There was no such problem in Pinawa.

- Not having a constant presence in both towns was a problem. (The T.E.A.M. Information Offices were closed during the summer and fall of 1984).

- More promotional work was done through the Pinawa schools than through schools in Stonewall. No explanation for this difference could be found.

- Businesses in both towns were impressed with T.E.A.M.

- The $30,000 prize was seen as important to only the Steering Committees. There was little interest in the prize by the general public.

7.7 FUTURE PROJECTS

If the project was to be repeated it is recommended that the Competition Guidelines be designed more or less with the same three principles or goals, namely, to encourage participation, to recognize actions taken to save energy, and to measure and reward for energy saved.

The prize was only important in motivating town leadership to participate. For this reason a prize had a positive effect. However the average town resident was not motivated to save energy by the competition aspect or the prize. Motivation to save energy came as a result of confidence in the advice given and the expectation of personal benefit (energy dollars saved).

Collecting monthly statistics is useful only if they are readily available or can be easily made available.

Changing the competition year would also be useful in future programs. Interest in energy conservation peaks in the fall. Thus, any such competition should begin around September 1 and end on August 31. People will be more inclined to have audits done and work performed in the fall in anticipation of savings over the winter.

Finally, it is beneficial to maintain a physical presence over the entire course of the competition. People may not use the office once the audits are completed, but will certainly notice and complain once the office is closed.

SECTION 8
COMMENTS ON ENERGY CONSERVATION PROGRAMS

8.1 INTRODUCTION

One of the benefits of T.E.A.M. was that it permitted simultaneous viewing of the response of various sectors to a concentrated energy conservation program. This led to a series of observations relating to such programs. Obviously these observations do not provide an exhaustive review of the subject nor are they supported by detailed investigation and documentation. Nonetheless, one of the objectives of T.E.A.M. was to identify and document insights, imperfect or incomplete as they may be, on multi-sector energy conservation programs. The comments which follow are offered within this context.

8.2 CHARACTERISTICS OF SUCCESSFUL ENERGY CONSERVATION PROGRAMS

Successful energy conservation programs require careful design, management and implementation. In this respect they are similar to other types of delivery-oriented programs. One of the more succinct descriptions of the characteristics of successful municipal energy conservation programs is reprinted below from Ref. 5.

> "Studies in both Canada and the United States reveal that the following factors have been particularly important in municipal conservation activities directed at internal operations:
>
> - strong and visible support from elected officials and senior administrators
> - strongly committed individuals
> - clearly defined objectives and targets
> - designated responsibility for the program (usually an individual accountable to a committee or to management)
> - a detailed data base on energy consumption
> - effective internal communications
>
> For officials planning municipal conservation activities these findings suggest some important considerations:
>
> - a sound organizational framework
> - a suitable system for recording and collecting data

> - careful program planning
> - a strategy for obtaining support
> - a means of monitoring program activities in relation to established objectives
> - effective internal communications
>
> Actual details of conservation programs will vary from one municipality to another. Indeed it is essential that conservation activities be tailored carefully for each community. Nonetheless, when a program is being set up officials should give serious thought to each of these requirements."

Although these comments were directed at municipal programs (i.e. single sector), they are generally applicable to multi-sector programs, especially if the program is to be delivered through municipal officials.

8.7 ENCOURAGING ENERGY CONSERVATION

Encouragement can be regarded as marketing. The marketing of any product or service will be most successful when it is promoted on the basis of the benefits which it produces. For energy conservation, these benefits can be economic or they can be non-economic. For example, a house which has been retrofitted to reduce heat loss and air leakage will generally be more comfortable with more uniform temperatures and fewer cold drafts. Further, it will be quieter because these measures will reduce noise transmission from the outdoors. Therefore these benefits can be promoted along with any economic advantages.

Encouraging an entire town, with all its sectors, to implement energy conservation is much more difficult than encouraging a single sector because each sector uses different decision-making criteria, is subject to different motivational forces and has access to different resources. Any promotional efforts must recognize these differences.

Encouragement and promotion of energy conservation considered, perhaps arbitrarily, to consist of two parts - the concept and the knowledge. Promoting the concept relates back to motivating decision-makers (whether government, corporations or individuals) to take action. As discussed, this will be most successful when they perceive acceptable personal gains and benefits as defined using their own criterion. The knowledge component on the other hand, is one of information or technology transfer - advising those who have made the decision to implement conservation so as to maximize their benefits.

The question is how to achieve these goals of influencing decision-makers and providing them with the necessary information. To answer this question is beyond the scope of this report. Many tactics and strategies have obviously been attempted, with varying degrees of success. Examination of these in more detail might well provide some insight.

One suggestion which has been made (Ref. 6) is as follows. The problem of promoting energy conservation is essentially one of publicizing the benefits and how they can be achieved. That is, pairing various technical problems to corresponding technical solutions. Parallel situations exist, and have existed for many years, in other fields. For example, consider agriculture. Farming is an activity which requires technical and economic acumen for survival. Departments of Agriculture have historically assisted the farmer through their extension divisions which are centred around local Ag. Reps. who are available to assist and guide the farmer. Although not highly visible programs, they have for years quietly worked at promoting sound technical and economic practices, always by maintaining very close contact with the farmer. Generally these "promotional" efforts have been very successful. Similar strategies and campaigns to promote energy conservation might well benefit from closer examinations of such programs to see how they have solved the same types of problems in their own fields.

SECTION 9
SUMMARY OF OBSERVATIONS AND CONCLUSIONS

9.1 INTRODUCTION

The T.E.A.M. project did not represent an exhaustive review of the opportunities and limitations of energy conservation in the various energy use sectors. Pinawa and Stonewall, their inhabitants, buildings and facilities may or may not be representative of other towns. Therefore, in reviewing the findings of this project, the reader is cautioned that T.E.A.M. was a very unique project, applied to two specific towns under very special conditions. The intense promotional efforts and attempts to stimulate activity through the competition further dictate that the findings should be carefully reviewed before applying them to other situations. In particular, quantitative results should be treated as representative of a single case study and not necessarily applicable to other towns. Nonetheless, T.E.A.M. did provide a vantage point from which a number of observations could be made, conclusions drawn and some recommendations offered.

9.2 OBSERVATIONS AND CONCLUSIONS

9.2.1 General

- T.E.A.M. demonstrated that identifiable reductions in energy consumption could be obtained in all energy use sectors with an intensive energy conservation program. However, it is not known whether the techniques used in T.E.A.M. to produce these savings (in terms of the level of effort, types of services offered, advertising, etc.) represented the optimum approach. It is recommended that future energy conservation programs evaluate a variety of possible strategies to find those best suited to meeting their goals.

9.2.2 Residential Module

- Homeowners in 50% of the eligible houses in the two towns requested the free energy audit. However these results were only obtained through a very intense public relations campaign.

- Scheduling of audits using dispatchers, rather than the auditors themselves proved extremely valuable.

- The T.E.A.M. experiences suggest that the overall calibre of personnel who could be trained as energy auditors is surprisingly good, although some effort is needed to identify them. A point of concern however, was the relatively poor (or forgotten) mathematical skills displayed by most individuals.

- The training of residential energy auditors should include: a thorough review of the qualitative aspects of house construction practices and qualitative and quantitative reviews of energy conservation techniques including the analysis procedures and a complete discussion of written and verbal communication including proper techniques for dealing with the public.

- Based on the T.E.A.M. experience with a fairly detailed audit program and previously untrained personnel, the appropriate length of the auditor training course should be approximately 4 to 5 weeks, with latter portions of the course consisting of some on-the-job training.

- The CMHC manual "Training in Housing Rehabilitation Skills; Course 1 – Inspecting Dwellings and Introduction to Specification Writing" was found to be an excellent document for reviewing house construction practices. The CMHC manual "Training in Housing Rehabilitation Skills; Course 3 - Energy Conservation in Rehabilitation" was also considered to be very good. However the sections dealing with analysis techniques were not considered to be suitable for large-scale audit delivery programs, although still useful as learning aids.

- At the completion of their course, auditors can be regarded as trained but not qualified for their roles and thus need further support.

- Under routine conditions, the audit delivery system should be designed on the basis of one house visit per audit. Exceptions might be cases of very complex houses or when new auditors are performing the audit, in which event two house visits may be necessary.

- The analysis procedures and forms used in T.E.A.M. to perform the energy audit served their purpose despite their excessive length and limited accuracy. On-going audit programs would require more refined techniques.

- The most valuable benefits of the energy audit, from the homeowners' perspective, were the qualitative recommendations which described "which" measures to undertake, "what" their priority should be and "how" they should be carried out. By priorizing the conservation options, the audit permitted homeowners to direct their efforts to achieve maximum benefits.

- Homeowners were often unaware of the benefits of the no-cost and low-cost measures.

- Perhaps the greatest benefit of the audit was that of advising homeowners what NOT to do rather than what to do.

- It is recommended that major residential energy audit programs be preceded or accompanied by a market survey of eligible homeowners and houses so that auditor training, audit procedures and various management considerations can be focused to address the needs of the eventual users.

9.2.3 Municipal Module

- Audits of the municipal facilities were well received and appeared useful in encouraging implementation of energy conservation measures.

- Building operators displayed a good understanding of the technical aspects of energy conservation but still welcomed the opportunity to discuss and confirm their beliefs with an outside authority.

- Perhaps the most valuable aspect of the audit was the prediction, with accuracy and confidence, of the anticipated savings of each conservation measure, thus permitting priorization of options on the basis of their payback periods.

- The fact that the energy audits were performed by a party external to their organizations appeared to improve the acceptance of the audit recommendation by the municipal boards responsible for operation of the facilities.

- The methods of economic analysis and comparison preferred by the building operators and the towns were relatively basic and did not include life cycle cost analysis.

- The ability of the municipalities to implement cost-effective recommendations was restricted by their access to the required funding.

9.2.4 Transportation Module

- General response to the Fuel Economy Diagnostic Clinics was enthusiastic and only two customer complaints were registered. Future multi-sector conservation programs could benefit from an expanded Transportation Module - because of the direct savings and the enthusiasm and interest which they generate. It may also be beneficial to schedule the clinics early in the program as a means of promoting the entire project.

- Based on observations by the Consultants and supported by discussions with the contractors, vehicle owners appeared quite willing to accept the clinic results and did not display any concern that they were performed by commercial operators who might benefit from repair work which was identified during the analysis.

- Although formal records were not maintained, casual observations and discussions with the clinic mechanics suggested that most vehicles processed by the clinics were operating in a reasonably efficient manner. More extensive work to improve efficiency was required on approximately 20% of the vehicles.

- Formal estimates of anticipated fuel savings were not prepared. However a subjective review by the Consultants suggested that average savings for all the vehicles processed would be in the order of 5%.

- If large-scale fuel economy clinics were considered it is recommended that better estimates of the savings resulting from them be determined. This could involve a rigourous determination of pre- and post-clinic mileage on a representative sample of vehicles. This would permit a more accurate determination of the cost-effectiveness of the clinics.

- It is recommended that to reduce the cost of future fuel economy clinics, it might prove possible to combine them with other, established programs such as the motor vehicle safety inspection programs. The marginal cost of the clinic could thus be held to a minimum and the convenience to the public maximized.

9.2.5 Industrial/Commercial/Institutional Module

- In general, Pinawa was more successful than Stonewall at implementing actions recommended by the audits. This outcome was largely caused by differences between the I/C/I sectors in the two towns. Since the success was based on the energy saved, the size of the building had a great effect on the economical energy savings. A limited amount of energy consumption limits the number of energy conservation techiques to no- and low-cost retrofits.

Consequently Stonewall was at a disadvantage when comparing its I/C/I buildings to that of Pinawa, because the buildings in Pinawa presented opportunities for more cost-effective measures.

- The program was also more effective in Pinawa due to the relative number of businesses. Population-wise, Stonewall and Pinawa are equal, but business-wise they are quite dissimilar. Stonewall, having a large number of businesses, required more effort to make the program as successful as it was in Pinawa. Whether or not the two towns received the same level of encouragement is unknown.

9.2.6 Statistical Base Module

- Collection of energy use data for the towns proved very difficult and time consuming due to a combination of poor or inaccessible data sources, the absence of submetering at the town level and the inability to quantify vehicle energy usage and wood consumption.
- The competition aspect of T.E.A.M. required a clearly defined set of Competition Guidelines agreed to in advance by all parties. The methods used to award points, namely on the basis of participation, action taken to save energy and energy saved, was found to be successful.
- Based on the enthusiastic participation in T.E.A.M. by children, one of the more successful ways to promote energy conservation, on a long-term basis, may be through its exposure to the young.
- The competition prize was only seen as important to the town Steering Committees of the towns. The average town resident was not motivated to save energy by the competition aspect or the prize.

REFERENCES

1. UNIES Ltd. and Appin Solar Associates Inc., "Energy Demo - Home Energy Saving Demonstration Program", 1985.
2. CMHC, "Training in Housing Rehabilitation Skills; Course 1 - Inspecting Dwellings and Introduction to Specification Writing", 1983.
3. CMHC, "Training in Housing Rehabilitation Skills; Course 3 - Energy Conservation in Rehabilitation", 1982.
4. UNIES Ltd., "An Evaluation of the Effectiveness of Air Leakage Sealing", 1983.
5. EMR, "ENERSAVE For Municipalities", Volume 2, 1982.
6. D. Young, personal communication.
7. Manitoba Dept. of Economic Development and Tourism, "1982 Report on Manitoba Communities", 1982.

APPENDIX A

DESCRIPTION OF TOWNS

CONTENTS:

DESCRIPTION OF PINAWA
DESCRIPTION OF STONEWALL

(from Ref. 7)

MANITOBA
DEPARTMENT OF
ECONOMIC DEVELOPMENT & TOURISM

Pinawa

October 1982 Community Report

Pinawa is Manitoba's "atomic age" town. The town is located 14.5km from the Whiteshell Nuclear Research Establishment. This community was established by Atomic Energy of Canada Ltd., and came into existence in 1963. This site, 121km northeast of Winnipeg on P.T.H. 11 and P.R. 211, on the Winnipeg River, was selected as the best place in which to build Manitoba's first nuclear research station. Full advantage has been taken of the natural setting and the town is planned in such a way as to retain the maximum amount of tree cover.

The major function of the Whiteshell Establishment is to conduct research into peaceful uses of nuclear energy with emphasis on the development of nuclear power plants.

Industries locating, expanding or modernizing in Pinawa, depending on size, may be eligible for either a Federal Government grant under the Regional Development Incentives Program or an interest free forgivable loan incentive under the Rural Small Enterprise Incentives Program.

Population

	Total	0-19	20-34	35-64	65+
1971 Census	2,190	1,025 (46.8%)	700 (31.9%)	460 (21.0%)	25 (1.1%)
1976 Census	2,080	945 (45.4%)	540 (25.9%)	585 (28.1%)	10 (0.5%)
1981 Census	2,011	810 (40.2%)	440 (21.8%)	740 (36.7%)	30 (1.4%)

Trading Area Population (incl. population of town) 2,000

Local Contacts

Mayor: J.H. Gilmour, 753-2311 ext. 209

Res. Admin.: R.A. Dale, 753-8228
L.G.D. Pinawa, Box 100, Pinawa, Man. R0E 1L0

East-Man Regional Development Inc.
Manag. Dir.: R. Howard, 268-2884 (Beausejour)
Pres. G. Catellier, 349-5224 (St. Malo)

Eastern Manitoba Tourist Assoc.
Contact: C. Zielke, 268-2884 (Beausejour)

Dept. of Economic Development & Tourism
Small Business Assistance Centre: 255-9640 (Winnipeg)

Dept. of Agriculture
Ag. Rep. L. Michalski, 268-1411 ext. 127 (Beausejour)
Home Ec. M. Zarecki
4-H Prog. Assist. R. Winnemuller

Tax Structure

Mill Rate: *Flat Rate* 178.9

Business Tax: 10% of assessed value

Utilities

Water
Source Winnipeg River. *Quality*: TH 50 mg/ℓ CaCO$_3$. *Spec. Cond.* 91 umhos. *Treatment* Settling, filter, chlorine, fluoride. *Capacity*: for a population of 3,000. *Rates*: No charge

Sewage
Treatment: Lagoon (3 cells)

Electrical
Contact the local Manitoba Hydro Representative or the Business Manager, Manitoba Hydro, 177 Main St., Selkirk, Man. R1A 1R5 Phone: 482-7811.

Heating Oil Suppliers
Imperial

Local Facilities

Ambulance - 1

Apartments - 3 (51 suites)

Assembly Halls - 3

Churches - Baptist, Catholic, Lutheran, Pinawa, Christian Fellowship.

Fire Protection - 25 volunteers, pumper, fire truck, rescue trucks

Garbage Disposal - Res. weekly, Comm. bi-weekly

Hospitals - 1 (17 beds)

Libraries - 1

Motels - 1 (11 suites)

Newspapers - 1

Police - 2 R.C.M.P.

Public Health Clinic - From Whitemouth

Radio Stns. - Winnipeg

Schools - 2 Elementary, 1 High

T.V. Stns. - Cable T.V. from Winnipeg

Transport

Rail: Freight: CNR - tri-weekly (Elma Stn.); CPR - as required (Lac du Bonnet Stn.). Passenger: VIA - daily (Whitemouth Stn.)

Bus: Grey Goose - Daily. Stops at Highway #1 at 211

Recreational Facilities

Curling rink, outdoor & indoor skating rink, ski & toboggan area, gymnasiums, 9-hole golf course, water-skiing, rifle range, beach, 98 boat marina, tennis courts, skeet shooting range, cross country skiing, figure skating and music lessons, outdoor public swimming pool

Festivals - Birthday Party (July)

Fraternities and Affiliations - Lions

Local Statistics

Retail Outlets: 2 (1966 census)

Service Outlets: 14 (1966 census)

Average Income of all Returns including surrounding area: $16,115/year (Revenue Canada 1980)

Business and Professional Services

Apparel and Accessories Group
- Jewellery Stores - 2

Automotive Group
- Automotive Parts & Accessories - 1
- Bulk Oil Dealers - 1
- Service Stations - 1
- Tire Sales & Service

Building and Hardware Group
- Building Contractors - 1
- Hardwares - 1
- Woodworking - 2

General Merchandise Group
- Department Stores - 1

Food & Beverage Group
- Eating Places - 2
- Eating Places with Beverage - 1

Furniture, Appliances and Home Accessories Group
- Furniture & Appliances - 3

Professional Group
- Dentists - 1
- Medical Doctors - 3
- Optometrists - 1 (visiting)

Financial Group
- Banks - 1
- Credit Unions - 1

Other Groups
- Barber Shops - 1
- Beauty Parlours - 2
- Drug Stores - 1
- Dry Cleaners - 1 (pick-up)
- Electrical Contractors - 1
- Florists - 1
- Gift Shops
- Hobby Shops - 2
- Painters and Decorators - 1
- Photographers - 1
- Plumbing and Heating - 1
- Sporting Goods - 3
- Travel Agents - 1

Industries/Employers

Firm - Products Services (Employees)

Assiniboine Credit Union
Atomic Energy of Canada Ltd. - research (800)
Dental Clinic
Hospital - (16)
Hudson's Bay Company - department store (11)
L.G.D. of Pinawa - (30)
Pinawa Motor Inn - (6)
Post Office - (4)
Whiteshell School District - (49)

MANITOBA
DEPARTMENT OF
ECONOMIC DEVELOPMENT & TOURISM

Stonewall

October 1982 Community Report

The Town of Stonewall, incorporated on June 1, 1908, is located 32 kilometers north of Winnipeg and can be reached from the city centre within 35 minutes. Because of its proximity to Winnipeg, many of Stonewall's residents commute daily to work in the city.

Outside of Stonewall is Oak Hammock Marsh Wildlife Management area — best described as a wetland wonderland — renowned by birdwatchers and waterfowl hunters for the spectacular numbers of geese and ducks which feed and rest within the 9,000 acre wetland and upland complex during migration. The early fall is the ideal time to see waterfowl numbering up to 300,000. The open-water season affords a view of more than 250 bird species and numerous other organisms, composing this rich, diverse, ecosystem. This area is on provincial road 223, 22.5 kilometers north of Winnipeg between Stonewall and Selkirk.

Stonewall is a farm service centre for the surrounding area which produces cereal grains, flax, rapeseed, beef cattle, hogs, poultry and milk.

A rocket propellant plant was built a few kilometers south of Stonewall in 1963 by Bristol Aerospace Ltd.

Kinsman Lake was constructed in one of the old quarries which are within the town limits. A beach and camping facilities are available at the Lake.

The Town of Stonewall recently embarked on an economic development program with the hiring of an economic development officer. Business information and site location assistance is available to potential new business and industry.

Industries locating, expanding or modernizing in Stonewall, depending on size, may be eligible for either a Federal Government grant under the Regional Development Incentives Program or an interest free forgivable loan incentive under the Rural Small Enterprise Incentives Program.

Population

	Total	0-19	20-34	35-64	65+
1971 Census	1 585	645 (40.7%)	295 (18.6%)	425 (26.8%)	205 (12.9%)
1976 Census	1 826	680 (37.2%)	405 (22.2%)	495 (27.1%)	260 (14.2%)
1981 Census	2 210	795 (35.9%)	555 (25.1%)	555 (25.1%)	300 (13.6%)

Trading Area Population (incl. population of town) 5 500

Local Contacts

Mayor: A. Krawec 467-8496

Sec.-Treas.: J. Mauws 467-5597

Eco. Dev. Officer: Curtis Whyte 467-5597
Town of Stonewall, Box 250, Stonewall, Man., R0C 2Z0

Tourism Manitoba - Interlake Region
Pres. G. Wiens 389-2818 (Wpg. Beach)
Sec.: Wm. Aitken 376-5165 5033 (Arborg)

Stonewall District Chamber of Commerce
Pres. W. Barron 467-5354
Sec. Mrs. S. Michaelides 467-8358
Treas. Mike Bell 467-5574

Dept. of Economic Development & Tourism
Small Business Assistance Centre
235-9640 (Winnipeg)

Dept. of Agriculture
Ag. Rep. Stan Stadnyk 467-5511
Home Ec. R. Kernested 467-5111
4-H Prog. Assist. J. Cavenagh

Tax Structure

Mill Rate: *Industrial & Commercial* (outside Local Improvement Dist.) 208.1; (Inside Local Improvement Dist.) 229.8. *Residential* (outside Local Improvement Dist.) 173.4 (Inside Local Improvement Dist.) 173.1

Business Tax: 5% of Assessed value

Utilities

Water
Source: Wells (town-owned and private) *Treatment*: Chlorination *Rates*: Commercial minimum quarterly charge - $54.72 + 48¢ - 69¢ cubic metre depending on quarterly consumption.

Sewage
Treatment: Lagoon (4 cells). *Capacity*: 82 - 7.3 - 10 acres, operating at 100% of capacity. Force main, lift station 2km trunk sewer and 8km laterals

Electrical
Contact the local Manitoba Hydro Representative or the Business Manager, Manitoba Hydro, 177 Main St., Selkirk, Man. R1A 1R5 Phone 482-7811.

Natural Gas Suppliers
Greater Winnipeg Gas Co.

Heating Oil Suppliers
Gulf, Imperial, Shell, Texaco

Local Facilities

Ambulance - 2

Apartments - 4

Assembly Halls - 5 (Capacity 1,500)

Churches - Anglican, Baptist, Catholic, Presbyterian, United

Day Care

Fire Protection - 1 fire chief, 17 volunteers, 2 pumpers

Garbage Disposal - Res. weekly, Comm. weekly

Hospitals - 1 (18 beds)

Hotels - 1 (10 suites)

Libraries - 1

Motels - 1 (5 suites)

Newspapers - 1

Personal Care Homes - 1 (30 units)

Police - 14 R.C.M.P.

Public Health Clinic - At hospital

Radio Stns. - Portage, Winnipeg

Schools - Kindergarten, 2 Elementary, 1 High

Sr. Citizens Homes - 2

T.V. Cable Service

T.V. Stns. - Pembina, Winnipeg

Transport

Rail: Freight, CPR - as traffic warrants.

Truck: Stonewall Freight, Monday to Saturday, 4 trucks

Bus: Grey Goose - daily

Recreational Facilities

Director: Heather Campbell

Indoor curling & skating rinks with artificial ice, bowling alley, park, baseball diamonds, campgrounds at Kinsmen Lake, agricultural grounds, tennis courts, billiard hall, senior hockey, baseball, music lessons, soccer and football

Festivals - Agricultural Fair (June)

Fraternities and Affiliations - Can. Assoc. for the Mentally Handicapped, Canadian Legion and Ladies Auxiliary. 4-H Clubs. Hospital Auxiliary. Kinettes. Kinsmen. Ladies Auxiliary groups connected to all churches. Oddfellows. Rebekahs. Rockwood Ag Society. Rockwood Horticultural Society. Senior Citizens Clubs

Available Buildings/Industrial Property

Contact J Mauws or Curtis Whyte 467-5597

Local Statistics

Retail Outlets: 30 (local est.) *Sales & Receipts* $7 million (local est.)

Service Outlets: 24 (local est.) *Sales & Receipts* $.75 million (local est.)

Average Income of all Returns including surrounding area: $11,312 year (Revenue Canada 1980)

Business and Professional Services

Apparel and Accessories Group
- Children's Wear - 1
- Fabric Stores - 1
- Family Clothing - 1
- Jewellers Stores - 1
- Ladies Wear - 1
- Shoe Stores - 1

Automotive Group
- Automotive Parts & Accessories - 4
- Body Repair Shops - 3
- Bulk Oil Dealers - 4
- Car Washes - 2
- Motor Vehicle Dealers - 3
- Service Stations - 3
- Tire Sales & Service - 2

Building and Hardware Group
- Building Contractors - 2
- Hardwares - 2
- Lumber Yards - 3

Food & Beverage Group
- Bakeries - 2
- Eating Places - 6
- Eating Places with Beverage - 2
- Food Processing - 1
- Grocery Stores - 2
- Liquor Commission - 1
- Supermarkets - 1

Furniture, Appliances and Home Accessories Group
- Electrical Appliances - 4
- Furniture Stores - 1
- T.V. and Radio - 1

Professional Group
- Accountants - 3
- Chiropractors - 2
- Dentists - 2
- Lawyers - 6
- Optometrists - 1
- Physicians - 5
- Veterinarians - 2

Financial Group
- Banks - 3
- Credit Unions - 1

Other Groups
- Animal Feed Industry - 2
- Barber Shops - 2
- Beauty Parlours - 4
- Billiard Parlours - 1
- Bookkeeping Income Tax Service - 2
- Book Stores - 1
- Bowling Alleys - 1
- Cabinet Maker - 1
- Carpet Cleaning - 1
- Dairy Supply Equipment - 1
- Dry Cleaners - 2
- Electrical Contractors - 2
- Electrical Equipment Repairs - 1
- Excavating - 2
- Fertilizers - 3
- Florists - 1
- Funeral Service - 1
- Furniture Installation - 1
- Grain Elevators - 1
- Hobby Shops - 1
- Industrial Design Marketing - 1
- Insurance - 1
- Janitorial Service - 1
- Laundries - 2
- Machine Shops Welding - 2
- Painters and Decorators - 2
- Pharmacies - 2
- Plastic Fabrication - 1
- Plumbing and Heating - 3
- Printers - 1
- Real Estate
- Refrig. & Air Conditioning - 2
- Renovators - 1
- Road Contractors - 1
- Sewage Services - 2
- Sporting Goods - 1
- Taxi - 1
- Tree Nursery - 1
- Trucking - 2
- Upholsterers - 1
- Waterfowl Conservation - 1

Industries/Employers

Firm - Products/Services (Employees)

Banks & Credit Union - (32)
Bristol Aerospace Ltd. (10km S.E. of town) - rocket propellant (120)
Comstock International Ltd. - road contractors, gravel (10)
Evelyn Memorial Hospital - (85)
Flexon Industries Ltd. - fibreglass products (4)
General Stone Products Ltd. - cut rocks (20)
Interlake Dairy Supplies - (2)
Interlake Graphics - (9)
Interlake Publishing Ltd. - printing & publishing (12)
Interlake School Division - (93)
Manitoba Hydro - (4)
Manitoba Telephone System - (6)
Mrs. K's Food Products - pizzas, specialty food (12)
Post Office - (5)
Provincial Municipal Planning Branch - (6)
Provincial Highways Branch - (14)
Red River Co-op Ltd. - pre-fabricated houses (10)
Rosewood Lodge - personal care home (4)
Salkeld Duck & Goose Hatchery - poultry products (2)
Stonewall Bakery - baked goods (2)
South Interlake Planning Branch - (2)
Standard Limestone Quarries (8km outside town) - cut rocks (15 + 7 seasonal)
Town of Stonewall - (6)
Village Bakery - (4)

APPENDIX B

RESIDENTIAL ENERGY AUDIT WORKSHEETS AND RECOMMENDATION FORMS

CONTENTS:

EXISTING CONDITIONS WORKSHEET - This two page worksheet documented the qualitative aspects of the house.

HOUSE SKETCH WORKSHEET - This two page worksheet provided space to sketch the house plan and dimension the house components.

ESTIMATION OF AVERAGE AIR CHANGE RATE - This one page nomograph used a balance between moisture production and moisture indicators to estimate the average winter air change rate.

SIMPLIFIED SAVINGS CALCULATIONS PROCEDURES WORKSHEETS - These 14 pages of worksheets were used to record data and calculate the energy and dollar savings from proposed energy conservation measures.

T.E.A.M. RESIDENTIAL ENERGY AUDIT REPORT - This two page report was delivered to the homeowner. The audit recommendations were divided into no-cost, low-cost and cost-effective recommendations.

EXISTING CONDITIONS

ADDRESS: ______________________________

DATE: __________ AUDITORS: ______________________

HOUSE DESCRIPTION: Age: __________ Type of Siding: ____________

Type: 1 Storey___ 1½ Storey___ 2 Storey___ 2½ Storey___ Bilevel___

Split Level___ Mobile Home___ Row House___ Other__________

Foundation: Basement___ Crawl Space___ Slab___ Other__________

Roof: Gable___ Cottage___ Deck___ Shed___ Other__________

Porches: Front___ Back___ Other Features______________

OCCUPANT LIFESTYLE DATA

Number of occupants: _____ Number at home during day: _____

Indoor air temperature: Day______ Night______

FOUNDATION

Evidence of differential settlement or heaving: ______________

Size and location of foundation cracks: ______________

Evidence of water leakage: ______________

Evidence of floor slab movement: ______________

EXTERIOR WALLS

Construction: Balloon___ Platform___ Other______________

Evidence of interior moisture damage: ______________

Evidence of exterior moisture damage: ______________

ATTIC

Evidence of moisture damage on ceiling or in attic: ______________

Attic venting: Type and number: ______________

Exhaust fans venting directly into attic: Yes______ No______

Number of pot lights extending into attic: ______________

HEATING SYSTEM

Type of fuel: ______________ Age of furnace: ______________

Type of heating system: F/A___ B/B___ Gravity air___ Other__________

Outdoor air duct to return air duct: ______________

Is heat distribution system adequate?: ______________

HEATING SYSTEM AND VENTILATION

List all combustion appliances: ________________

Chimney: Exterior___ Interior___ Type________________

Supplemental heating (wood stove, plug-in elec., etc.): ________

Location of all exhaust fans: ________________

Exhaust fans leaking cold air or dripping water: ________

Humidifer? and usage: ________________

AIR INFILTRATION AND AIR QUALITY

Unusual odours or stuffiness: ________________

Winter humidity levels: Low___ Medium___ High___

Venting currently required in winter?: ________________

Mould or mildew on any surfaces?: ________________

Frost on exterior wall outlets, in corners, etc.: ________

Cold draughts: ________________

Describe window condensation: ________________

Types of windows: ________________

ELECTRICAL SYSTEM

Age and condition of existing wiring: ________________

Amperage capacity: ________ Car plug timers?: ________

Other comments: ________________

PLUMBING SYSTEM

Age and general condition: ________________

Water supply: City___ Well___ Other________________

Wastewater disposal: City___ Septic Field___ Other________

Hot water tank: Fuel____ Size________ Comments________

Clothes washer (warm or hot cycle): ________ Dishwasher: ________

PROBLEMS WITH HOUSE AND GENERAL COMMENTS

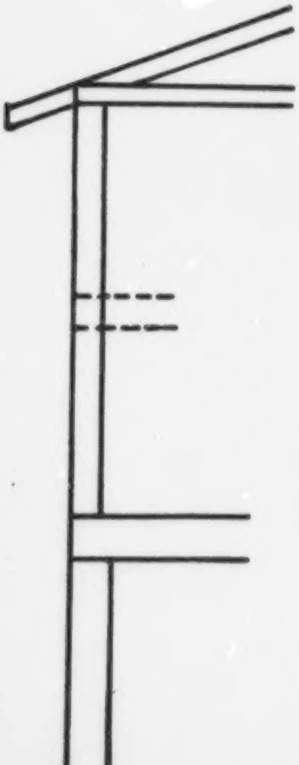
____

____

____

____

ADDRESS: ______________________________ Stonewall, Man.



COMPONENT DESCRIPTION AND DIMENSIONS	GROSS - AREA (m^2)	DOORS = +WIND.	NET AREA	RS
1. CEILINGS:				
2. MAIN WALLS:				

COMPONENT DESCRIPTION AND DIMENSIONS	GROSS - AREA (M^2)	DOORS - +WIND. (M^2)	NET AREA (M^2)	RSI
3. DOORS:				
4. HEADER:				
5. BASEMENT ABOVE GRADE: height= m.				
6. BASEMENT WALL AREA FROM GRADE TO FLOOR:				
7. WINDOWS: SIZE SOUTH:	PANES NO. OF		AREA NET	RSI
OTHERS:				

ESTIMATION OF AVERAGE AIR CHANGE RATE

Circle the applicable conditions and add up the circles:

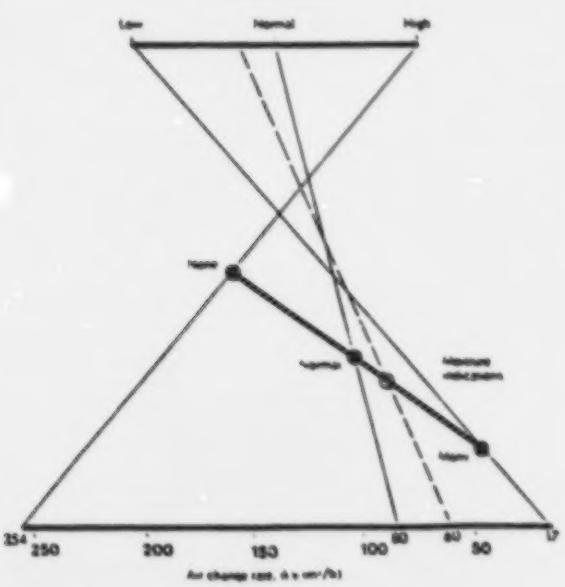
Moisture Production	Low	Normal	High
People per 100 m^2 of liveable area	1-2	3-4	5+
Basement	cold	cool	warm
Basement	dry	damp	wet
Clothes drying in winter	outdoors		indoors
Clothes dryer is vented	outdoors		indoors
Humidifier is used in winter?	no		yes
Total number of circles			

Winter Moisture Indications	None	Normal	Many
Fogging of double-glazed windows*	never	occasional	frequent
Fogging of single-glazed windows	occasional	frequent	continuous
Water accumulation on window sills /wall stains below windows	never/none	seldom/rare	freq./some
Mould on interior surfaces	never	rare	common
Total number of circles			

Estimated air change rate from nomograph below: ________ m^3/h

Divided by total heated volume of dwelling: ________ m^3

Equals ESTIMATED AVERAGE AIR CHANGE RATE: ________ AC/h



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*Fogging on interior side of innermost glazing.

SIMPLIFIED SAVINGS CALCULATIONS PROCEDURES

SECTION I: GENERAL DATA

CEILINGS AND EXPOSED FLOORS:

Type	1	2	3	4	5
Description					
Gross Area (m^2)					

MAIN WALLS:

Type	1	2	3	4	5
Description					
Gross Area (m^2)					
less doors (m^2)					
windows (m^2)					
headers (m^2)					
Net Area (m^2)					

DOORS:

Type	1	2	3
Gross Area (m^2)			

WINDOWS:

Type	1	2	3	4	5
Description					
Gross Area (m^2)					

FRAMING PERCENTAGES:

Assembly	Framing Spacing (mm)	% Area Framing	% Area W/O Framing
Ceiling/ Floor	400	10	90
	600	7	93
Wall	400	19	81
	600	11	89

GENERAL DATA (continued)

BASEMENT (includes slabs on grade, crawl spaces, bilevels, full basements):

Walls Above Grade:

Type	1	2	3	4	5
Description					
Gross Area (m^2)					
less doors (m^2)					
windows (m^2)					
headers (m^2)					
Net Area (m^2)					

Walls Below Grade:

Type	1	2	3	4	5
Description					
Perimeter (m)					
Gross Area (m^2)					

Floor At/Below Grade:

Type	1	2	3	4	5
Description					
Depth Below Grade (m)					
Gross Area (m^2)					

BASEMENT FURRING: % AREA

Furring type	1	2	3
Description			
Furring dimension parallel to wall (A)	mm	mm	mm
Furring spacing (B)	mm	mm	mm
Furring height (C)	mm	mm	mm
% Area with framing = $\frac{A(C+(2\times B))}{C\times B}\times 100$	%	%	%
% Area without framing = 100% - % area with framing	%	%	%

SECTION II: ORIGINAL AND UPGRADED R VALUES

CEILINGS AND EXPOSED FLOORS

Type: Description:

ORIGINAL

Component	R through insulation	R through frame
Joist*		
Insulation		
	R_{IO}=	R_{FO}=

$$R_{TO} = \frac{100}{\dfrac{\%\ \text{W/O Framing}\ \boxed{}\ \%}{R_{IO} = \boxed{}} + \dfrac{\%\ \text{Framing}\ \boxed{}\ \%}{R_{FO} = \boxed{}}} = \boxed{}$$

* If existing insulation level is less than joist height:

insulation thickness ; R/mm (wood)

R(joist) = ☐ mm X 0.0087 = ☐

If existing insulation covers joists:

joist depth ; R/mm (wood) ; insulation above joist ; R/mm (insulation)

R(joist) = ☐ mm X 0.0087 + (☐ mm X ☐) = ☐

UPGRADED Do #1 or #2

#1. Component	R through insulation	R through frame
	R_{IU}=	R_{FU}=

$$R_{TU} = \frac{100}{\dfrac{\%\ \text{W/O Framing}\ \boxed{}\ \%}{R_{IU} = \boxed{}} + \dfrac{\%\ \text{Framing}\ \boxed{}\ \%}{R_{FU} = \boxed{}}} = \boxed{}$$

#2. If existing insulation is covering joists:

R_{TO} ; insulation thickness ; R/mm

R_{TU} = ☐ + (☐ mm X ☐) = ☐

MAIN WALLS

Type: Description:

ORIGINAL

Component	R through insulation	R through frame
	R_{IO}=	R_{FO}=

$$R_{TO} = \frac{100}{\dfrac{\%\ \text{W/O Framing}\ \square\ \%}{R_{IO} = \square} + \dfrac{\%\ \text{Framing}\ \square\ \%}{R_{FO} = \square}} = \square$$

UPGRADED Do #1 or #2

#1. Component	R through insulation	R through frame
	R_{IU}=	R_{FU}=

$$R_{TU} = \frac{100}{\dfrac{\%\ \text{W/O Framing}\ \square\ \%}{R_{IU} = \square} + \dfrac{\%\ \text{Framing}\ \square\ \%}{R_{FU} = \square}} = \square$$

#2. If wall is upgraded using insulating sheathings W/O framing:

$$R_{TU} = \underset{R_{TO}}{\square} + (\underset{\text{insulation thickness}}{\square}\ \text{mm} \times \underset{\text{R/mm}}{\square}) + (\underset{\text{covering thickness}}{\square}\ \text{mm} \times \underset{\text{R/mm}}{\square})$$

$$= \square$$

HEADER AREAS

Type: Description:

ORIGINAL

Component	R Value
	R_{TO}=

UPGRADED

Component	R Value
	R_{TU}=

Type: Description:

ORIGINAL

Component	R Value
	R_{TO}=

UPGRADED

Component	R Value
	R_{TU}=

Adjusted R Values
for
Joist Header Areas

R Value of Insulation	Adjusted R Value
1.4	1.2
1.7	1.4
2.1	1.7
2.4	1.8
3.5	2.8
4.9	3.9

BASEMENT WALLS ABOVE GRADE

Type: Description:

ORIGINAL

Component	R through insulation	R through* frame
	$R_{IO}=$	$R_{FO}=$

$$R_{TO} = \frac{100}{\dfrac{\%\ \text{W/O Framing}\ \square\ \%}{R_{IO}=\square} + \dfrac{\%\ \text{Framing}\ \square\ \%}{R_{FO}=\square}} = \square$$

* If original wall is not insulated or finished, $R_{TO} = R_{IO}$, i.e., this column is not required.

UPGRADED Do #1 or #2

#1. Component	R through insulation	R through frame
	$R_{IU}=$	$R_{FU}=$

$$R_{TU} = \frac{100}{\dfrac{\%\ \text{W/O Framing}\ \square\ \%}{R_{IU}=\square} + \dfrac{\%\ \text{Framing}\ \square\ \%}{R_{FU}=\square}} = \square$$

#2. If additional insulation and covering is secured W/O framing:

$$R_{TU} = \underset{R_{TO}}{\square} + (\underset{\text{insulation thickness}}{\square}\ \text{mm} \times \underset{\text{R/mm}}{\square}) + (\underset{\text{covering thickness}}{\square}\ \text{mm} \times \underset{\text{R/mm}}{\square}) = \square$$

BASEMENT WALLS BELOW GRADE - Calculate R values of added materials only (exclude wall itself and air films)

Type: Description:

ORIGINAL*

Component	R through insulation	R through frame
	$R_{IO}=$	$R_{FO}=$

$$R_{TO} = \frac{100}{\frac{\%\text{ W/O Framing }\boxed{}\,\%}{R_{IO}=\boxed{}} + \frac{\%\text{ Framing }\boxed{}\,\%}{R_{FO}=\boxed{}}} = \boxed{}$$

* If original wall is not insulated or finished, $R_{TO} = 0$

Choose appropriate heat loss factor:

HLF_o = ☐ $W/^oC \cdot m$

$G_o = \underset{HLF_o}{\boxed{}} \times \underset{\text{Perimeter}}{\boxed{}} = \boxed{}$ $W/^oC$

UPGRADED Do #1 or #2

Component	R through insulation	R through frame
	$R_{IU}=$	$R_{FU}=$

$$R_{TU} = \frac{100}{\frac{\%\text{ W/O Framing }\boxed{}\,\%}{R_{IU}=\boxed{}} + \frac{\%\text{ Framing }\boxed{}\,\%}{R_{FU}=\boxed{}}} = \boxed{}$$

Choose appropriate heat loss factor:

HLF_u = ☐ $W/^oC \cdot m$

$G_u = \underset{HLF_u}{\boxed{}} \times \underset{\text{Perimeter}}{\boxed{}} = \boxed{}$ $W/^oC$

WINDOWS

	ORIGINAL			UPGRADED	
	Locations	Description	R_{TO}	Description	R_{TU}
Type 1					
Type 2					
Type 3					
Type 4					
Type 5					
Type 6					
Type 7					

DOORS

	ORIGINAL				UPGRADED		
	Locations	Description	R Values door +films +storm	R_{TO}	Description	R Values door +films +storm	R_{TU}
Type 1							
Type 2							
Type 3							

SECTION III: HEAT LOSS SUMMARY: ORIGINAL AND UPGRADED

HEAT LOSS DUE TO CONDUCTION (G_c)

			ORIGINAL		UPGRADED	
Component		Area m^2	R_{TO} $m^2 \cdot {}^oC/W$	Area÷R_{TO} $W/{}^oC$	R_{TU} $m^2 \cdot {}^oC/W$	Area÷R_{TU} $W/{}^oC$
Ceilings and Exposed Floors	Type 1					
	2					
	3					
	4					
	5					
Main Walls	Type 1					
	2					
	3					
	4					
	5					
	6					
Main Wall Headers	Type 1					
	2					
Doors	Type 1					
	2					
	3					
Windows	Type 1					
	2					
	3					
	4					
	5					
	6					
Basement Walls Above Grade	Type 1					
	2					
	3					
	4					
	5					
Basement Wall Headers	Type 1					
	2					
	3					
	4					
	5					
Below Grade Foundation	Type					
				$G_{co}=$		$G_{cu}=$

HEAT LOSS DUE TO AIR CHANGE (G_a)

	House Volume		Air chg. per hour			
Original	☐ m^3	X	☐	X 0.335 =	$G_{ao}=$	
Upgraded	☐ m^3	X	☐	X 0.335 =		$G_{au}=$

TOTAL HEAT LOSS ($G = G_c + G_a$) in $W/{}^oC$	$G_o=$		$G_u=$

SECTION IV: SAVINGS DUE TO HEATING SYSTEM AND/OR ENVELOPE UPGRADING

Retrofit Combination No.				
Description of Retrofit Measures				
Original:	heating system type			
	fuel cost in \$/GJ (C_o)			
	seasonal efficiency (E_o)			
	heat loss coefficient (G_o)			
	$G_o \div E_o$ in W/°C (Y_o)			
	$C_o \times G_o \div E_o$ in W·\$/°C·GJ (Z_o)			
Upgraded:	heating system type			
	fuel cost in \$/GJ (C_u)			
	seasonal efficiency (E_u)			
	heat loss coefficient (G_u)			
	$G_u \div E_u$ in W/°C (Y_u)			
	$C_u \times G_u \div E_u$ in W·\$/°C·GJ (Z_u)			
Degree days (D)				
Energy Savings in kWh/year: $S_{GE} = 20 \times D \times (Y_o - Y_u) \div 1000$				
First Year Savings in \$/year: $20 \times D \times (Z_o - Z_u) \times 0.0036 \div 1000$				
Estimated Retrofit Cost:	materials only			
	materials and labour			
Simple Payback in years:	materials only			
	materials and labour			

SECTION V: SAVINGS DUE TO A SINGLE COMPONENT UPGRADE (above-grade components only)

Improvement No.	(Z)				
Description					
Area of the component in m^2	(A)				
R value prior to upgrading in $m^2 \cdot {}^oC/W$	(R_{TO})				
R value after upgrading in $m^2 \cdot {}^oC/W$	(R_{TU})				
$G_{ZO} = A \div R_{TO}$ in $W/{}^oC$	(G_{ZO})				
$G_{ZU} = A \div R_{TU}$ in $W/{}^oC$	(G_{ZU})				
$G_{ZO} - G_{ZU}$ in $W/{}^oC$					
Degree days	(D)				
Fuel					
Furnace efficiency	(E)				
Fuel cost in \$/GJ					
Energy Savings in kWh/year $S_{GZ} = \dfrac{20 \times D \times (G_{ZO} - G_{ZU}) \div 1000}{E}$	(S_{GZ})				
Dollar Savings in \$/year S_{GZ}(kWh/year) X 0.0036(GJ/kWh) X Fuel cost(\$/GJ)					

SECTION VI: SAVINGS DUE TO ADDITIONAL INSULATION ON BELOW-GRADE FOUNDATION

Improvement No.						
Description						
From Section II:	HLF_o in W/$^oC\cdot m$	(HLF_o)				
	HLF_u in W/$^oC\cdot m$	(HLF_u)				
	Perimeter in m	(P)				
$HLF_o - HLF_u$ in W/$^oC\cdot m$						
Degree days		(D)				
Fuel						
Furnace Efficiency		(E)				
Fuel cost in \$/GJ						
Energy Savings in kWh/year: $S_F = \frac{20 \times D \times P \times (HLF_o - HLF_u) \div 1000}{E}$		(S_F)				
Dollar Savings in \$/year: S_F(kWh/year) X 0.0036(GJ/kWh) X Fuel cost(\$/GJ)						

SECTION VII: SAVINGS DUE TO FURNACE IMPROVEMENT ALONE

Improvement No.				
Description				
From Sections II and III: G_o in W/^oC (G_o)				
Original fuel				
Original furnace efficiency (E_o)				
Original fuel cost in \$/GJ $(COST_o)$				
Upgraded fuel				
Upgraded furnace efficiency (E_u)				
Upgraded fuel cost in \$/GJ $(COST_u)$				
Degree days (D)				
Energy Savings (Delivered Energy) in kWh/year: $S_E = 20 \times D \times G_o \times (\frac{1}{E_o} - \frac{1}{E_u}) \div 1000$ (S_E)				
Dollar Savings in \$/year: $20 \times D \times G_o \div 1000 \times 0.0036 \times (\frac{COST_o}{E_o} - \frac{COST_u}{E_u})$				

SECTION VIII: SAVINGS DUE TO SINGLE, MULTIPLE, OR TOTAL ENVELOPE UPGRADE

Improvement Combination No.					
Description					
From Section III: G_o in $W/^{o}C$	(G_o)				
G_u in $W/^{o}C$	(G_u)				
$G_o - G_u$ in $W/^{o}C$					
Degree days	(D)				
Fuel					
Furnace efficiency	(E)				
Fuel cost in \$/GJ					
Energy Savings in kWh/year: $S_G = \frac{20 \times D \times (G_o - G_u) \div 1000}{E}$	(S_G)				
Dollar Savings in \$/year: S_G(kWh/year) X 0.0036(GJ/kWh) X Fuel cost(\$/GJ)					

T.E.A.M. RESIDENTIAL ENERGY AUDIT REPORT

OCCUPANT(S) ________________________________
ADDRESS ________________________________
____
____

HOME PHONE # ______________ WORK PHONE # ______________
DATE AUDIT COMPLETED ______________ AUDITOR(S) ______________

NO COST/LOW COST RECOMMENDATIONS

THE FOLLOWING ENERGY CONSERVATION RECOMMENDATIONS CAN BE IMPLEMENTED FOR LITTLE OR NO COST AND ARE THEREFORE SUGGESTED AS FIRST STEPS TOWARDS SAVING ENERGY IN YOUR HOME:

☐ REDUCE DAYTIME THERMOSTAT SETTING TO: _____°C (CURRENTLY: __°C)

☐ REDUCE NIGHTIME THERMOSTAT SETTING TO: _____°C (CURRENTLY: __°C)

☐ LOWER THERMOSTAT SETTING WHEN HOUSE IS UNOCCUPIED FOR EXTENDED PERIODS OF TIME TO: 10°C _____, 15°C _____

☐ USE AUXILIARY HEATERS TO PROVIDE "ZONE HEATING" AND THEN LOWER THERMOSTAT SETTING

☐ CLOSE OFF UNUSED ROOMS

☐ LOWER THERMOSTAT SETTING ON HOT WATER TANK TO A MAXIMUM OF 50°C (60°C IF HOUSE HAS A DISHWASHER)

☐ TRY INSTALLING FLOW RESTRICTORS ON SHOWER HEADS (IF POSSIBLE)

☐ CLOSE DRAPES AT NIGHT

☐ EXHAUST ELECTRIC DRYER INTO HOUSE DURING WINTER MONTHS UNLESS YOU HAVE OR MAY HAVE A HIGH HUMIDITY OR CONDENSATION PROBLEM (DO NOT EXHAUST GAS DRYERS INTO HOUSE)

☐ ________________________________
____

☐ ________________________________
____

☐ HAVE FURNACE SERVICED ANNUALLY (APPROX. COST $ _____)

☐ INSTALL POWER SAVER CORD OR CAR PLUG TIMER (APPROX. COST $ _____)

☐ INSTALL AUTOMATIC NIGHT SET-BACK THERMOSTAT (APPROX. COST $_____)

☐ ________________________________
____

☐ ________________________________
____

COST EFFECTIVE RECOMMENDATIONS

THE FOLLOWING ENERGY CONSERVATION RECOMMENDATIONS WILL REQUIRE A LARGER CASH OUTLAY BUT SHOULD STILL PROVE COST-EFFECTIVE:

RECOMMENDATIONS	APPROX. COST	APPROX. FIRST YEAR SAVINGS	SIMPLE PAY-BACK (YEARS)

OTHER COMMENTS

APPENDIX C

TRANSPORTATION MODULE REPORTS

CONTENTS:

ENGINE PERFORMANCE TEST REPORT

DIAGNOSTIC REPORT

SUN SLEUTH ONE/SLEUTH TWO
ENGINE PERFORMANCE TEST REPORT

CUSTOMER NAME ______________________ PHONE ____________ DATE ____________
ADDRESS ______________________ CITY/STATE ______________________ LICENSE ____________
MAKE/YEAR/MODEL ______________________ MILEAGE ____________ MILEAGE SINCE TUNE-UP ____________
ENGINE ______________________ TRANSMISSION—AUTO ☐ STD ☐ AIR CONDITIONING—YES ☐ NO ☐
CARBURETOR ____________ IGNITION TYPE ____________ AIR PUMP—YES ☐ NO ☐ CONVERTER—YES ☐ NO ☐
CUSTOMER COMMENTS ______________________ TESTED BY ______________________

TEST MODE	TEST	READ	ENTER SPECIFICATIONS		TEST RESULTS	COMMENTS
ENGINE OFF, KEY OFF	BATTERY VOLTAGE	DIGITAL DISPLAY	VOLTS			
ENGINE OFF, KEY ON	DISTRIBUTOR RESISTANCE *	DIGITAL DISPLAY	VOLTS (MAX)			
CRANKING	COIL OUTPUT +	SCOPE (DISPLAY)	KV (MIN)			
	VACUUM +	VACUUM GAUGE	VACUUM (MIN)			
	DWELL +	DIGITAL DISPLAY	DEG./PERCENT			
	BATTERY VOLTAGE +	DIGITAL DISPLAY	VOLTS (MIN)			
RUNNING 2500 RPM (HIGH CRUISE)	ALTERNATOR CONDITION	SCOPE (ALT) RASTER	EVEN RIPPLE			
	DWELL	DIGITAL DISPLAY	DEG./PERCENT			
	TIMING ADVANCE	TIMING LIGHT	DEGREES			
	MANIFOLD VACUUM	VACUUM GAUGE	VACUUM (MIN)			
	HC (HYDROCARBONS) □	HC DIGITAL DISPLAY	PPM			
	CO (CARBON MONOXIDE) □	CO DIGITAL DISPLAY	PERCENT			
	CHARGING VOLTAGE	DIGITAL DISPLAY	VOLTS (MAX)			
RUNNING 1500 RPM (LOW CRUISE)	COIL POLARITY	SCOPE (DISPLAY)	VISUAL			
	SPARK PLUG FIRING VOLTAGE	SCOPE (DISPLAY)	KV			
	MAXIMUM COIL OUTPUT *	SCOPE (DISPLAY)	KV (MIN)			
	SECONDARY INSULATION *	SCOPE (DISPLAY)	VISUAL			
	SECONDARY RESISTANCE	SCOPE (RASTER)	VISUAL			
	COIL—CONDENSER	SCOPE (RASTER)	VISUAL			
	BREAKER POINT CONDITION *	SCOPE (RASTER)	VISUAL			
	CYLINDER TIMING	SCOPE (SUPERIMPOSED)	VISUAL			
	CHARGING VOLTAGE	DIGITAL DISPLAY	VOLTS (MAX)			
	MANIFOLD VACUUM	VACUUM GAUGE	VACUUM (MIN)			
	HC (HYDROCARBONS) □	HC DIGITAL DISPLAY	PPM			
	CO (CARBON MONOXIDE) □	CO DIGITAL DISPLAY	PERCENT			

CYLINDER POWER BALANCE	ENGINE	DIGITAL DISPLAY				BASE RPM				BASE VACUUM			
	CYLINDER	1	2	3	4	5	6	7	8	9	10	11	12
	VACUUM CHANGE												
	RPM CHANGE												

SNAP ACCELERATION	SPARK PLUGS UNDER LOAD	SCOPE (DISPLAY)	KV (MAX)			
	ACCELERATOR PUMP ACTION □	CO DIGITAL DISPLAY	PERCENT (MIN)			
RUNNING IDLE	RPM	DIGITAL DISPLAY	RPM			
	DWELL	DIGITAL DISPLAY	DEG./PERCENT			
	INITIAL TIMING	TIMING LIGHT	DEGREES			
	CHARGING VOLTAGE	DIGITAL DISPLAY	VOLTS (MAX)			
	MANIFOLD VACUUM	VACUUM GAUGE	VACUUM (MIN)			
	HC (HYDROCARBONS) □	HC DIGITAL DISPLAY	PPM			
	CO (CARBON MONOXIDE) □	CO DIGITAL DISPLAY	PERCENT			

* This test is not recommended for electronic ignition systems.
+ Perform this test under no-start and hard start conditions.
□ For use with the SLEUTH TWO Engine Performance Analyzer.

692-1126 (2801)

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DIAGNOSTIC REPORT

CUSTOMER NAME:______________________ PHONE:__________ DATE:__________

ADDRESS:__________________________ LICENSE #:____________________

YEAR/MAKE/MODEL: ________________________ ENGINE:________________

Thank you for participating in the Fuel Economy Diagnostic Clinic.

Attached to this sheet is your Engine Performance Test Report. It is a detailed analysis of the mechanical condition of your vehicle's engine. From this information, the Clinic Mechanic was able to detect problems which may be reducing your fuel economy.

Minor items, like simple adjustments, have already been performed as a free service of the Clinic. However, any more serious engine problems are listed below, along with an explanation of what should be done to correct them. Your Clinic Mechanic will be happy to answer any questions, and will advise you in making decisions which will help you get the most from your repair dollars.

Problem: Recommended Repair:

____

____

____

____

____

____

Clinic Mechanic:______________

APPENDIX D

T.E.A.M. COMPETITION GUIDELINES

COMPETITION GUIDELINES
FOR THE
TOWN ENERGY AUDIT MATCH (TEAM)

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III. THE AGREEMENT BETWEEN THE TOWNS, THE PROVINCE OF MANITOBA AND THE GOVERNMENT OF CANADA .... 8.

I. INTRODUCTION , THE COMPETITION

The Town Energy Audit Match (TEAM) is a competition designed to save energy between the Towns of Stonewall and Pinawa, Manitoba. The TEAM competition guidelines must be designed in such a way so that the Steering Committees in both towns understand and agree, in writing, to the guidelines. The guidelines should be designed so as to reflect the major thrusts of the TEAM programme. These major thrusts are to:

1. Heighten people's awareness to the need to save energy by encouraging their participation in TEAM activities.
2. Encourage people to take action to save energy, based upon the energy audits and the programme advisors.
3. Demonstrate that the heightened awareness and individual actions will result in energy savings in both towns.

This paper briefly outlines the weights that should be given to each of the three components. The proposed total number of points is 100,000 and are distributed as follows:

Component 1: Heightening Awareness	20,000
Component 2: Recognition of Actions Taken	50,000
Component 3: Measurement of Energy Saved	30,000
Total Points	100,000

II. DESCRIPTION OF POINTS STRUCTURE

It should be stressed that the TEAM Competition Guidelines must be designed so as to account for the differences found in both towns. There are different numbers of houses, cars, commercial establishments, etc. The points structure must reflect these differences. It must also be stressed that the engineering consulting teams are the judges of the competition and that their decisions are final. The engineers are responsible for awarding points and for determining the eventual outcome of the competition.

2.1 Component 1: Heightening Conservation Awareness.

2.11 Residential Module.

Points will be awarded in this module on the number of houses participating in the residential audits. Homeowners and tenants, referred to as households, will be awarded points if they request and have an energy audit done on their dwelling units. The total score for 100% participation is 5,000 points.

2.12 Commercial/Industrial/Institutional Module

Points will be awarded in this module on participation by merchants, industrialists and institutions in the energy bus audit programme. Points will be awarded on percentage participation based on square meters of conditioned floor space, to a maximum of 3000 points. Participation means requesting an audit and adequately completing and returning an audit questionnaire form.

An example calculation showing the prorating of points over the conditioned floor spaces is as follows:

Total Square Metres of Conditioned Floor Space by Town

Town A	100,000
Town B	50,000

Total Square Metres of Audited * Floor Space

Town A	50,000
Town B	30,000

Points Awarded

Town A	50% x 3000 = 1500
Town B	60% x 3000 = 1800

* Audited facilities will include those having returned adequately completed questionnaires.

2.13 Transportation Module

The major emphasis in this module is the participation by automobile owners in the car clinics to be held in each town. All households will receive a form which will permit each household to have one car go through the clinic. Points will be awarded on the percentage participation by each town in the car clinic programme.

As there were approximately 700 application forms distributed in each town, each car going to the clinic will receive 7 points, for a maximum total of 5,000 points.

2.14 Municipal Module

This module essentially represents the town Steering Committee activities. As such, no points will be awarded in this component for this module. The work of the committee is reflected in the scores achieved in the other components.

2.15 ATTENDANCE AT SEMINARS

There will be a series of seminars for households and business people on ways to save energy. It is proposed that 5 points will be awarded for each householder, business person, etc. attending the seminars, to a maximum of 3,000 points. If attendance is greater than 600 people, (600 persons x 5 points per person = 3,000 points), the town with the greater attendance will receive a percentage of the points as compared to the winning town. Thus if one town has 800 persons and the other 500, the winner would receive 3,000 points, whereas the other would receive $\frac{500}{800} \times 3000 = 1875$ points.

It should be noted that the most recent census figures from the 1982 Manitoba Community Handbook shows that Stonewall has 1,110 persons between the ages of 20 and 64 and Pinawa has 1,180. Thus, the towns have relatively comparative populations.

2.16 SCHOOL POSTER CONTEST

One of the most important goals of the TEAM program is to encourage energy conservation among the children. It is proposed that a poster contest will be held within each town for children in Grades K - 12. Five points would be awarded for each child entering a poster to a maximum of 1000 points. An adjustment would be made on a percentage basis if more than 200 posters were entered. Again, the total points would be prorated or derated by the ratio of eligible participants between the two towns. The contest would not be between the towns. Rather, the contests would be within the towns and would be supervised by the town committees. Prizes and competition structure would be determined by the towns themselves.

It should be noted that the two towns have relatively comparative school age populations as Stonewall has 795 persons under age 20 and Pinawa has 810 under age 20. (Based on the 1982 Manitoba Community Handbook).

2.17 SPECIAL CONTESTS MODULE

Over the course of the competition year, it is likely that there will be a wide range of projects undertaken by both towns. There will be 3,000 points reserved for future contests, energy fairs, etc. to be awarded by the engineering consulting team. If there are contests or competitions undertaken by the agreement of both towns, the competition contract would be amended and points would be awarded by the engineers.

2.18 SUMMARY OF POINTS TO BE AWARDED IN COMPONENT 1.

2.11	Residential Module	5,000
2.12	Commercial/Industrial/Institutional	3,000
2.13	Transportation Module	5,000
2.14	Municipal Module	0
2.15	Attendance at Seminars	3,000
2.16	School Poster Contest	1,000
2.17	Special Contests	3,000
	Total Maximum Possible Points	20,000

2.2 COMPONENT 2: RECOGNITION OF ACTION TAKEN TO SAVE ENERGY

The energy audits done on all modules will identify or recommend specific actions to be underaken to save energy. Points will be awarded on the householders, business persons, etc. response to recommendations outlined in the energy audits.

2.21 RESIDENTIAL MODULE

The points awarded will be based upon a survey of each household to be undertaken by the consulting team near the end of the competition. The total points to be awarded is 30,000. The 30,000 points would be divided by the number of residential households in each town.

Example:

Number of Houses:

Town A	600
Town B	500

Number of potential points per house:

Town A $\frac{30{,}000 \text{ PTS}}{600 \text{ Houses}} = 50$ Points/House

Town B $\frac{30{,}000 \text{ PTS}}{500 \text{ Houses}} = 60$ Points/House

Each household would receive points for the energy conservation measures undertaken by the homeowner or tenant that were recommended by the auditor. The recommendation form has three components, namely the no-cost, low-cost (under $100 in materials) and cost effective recommendations. The homeowner would receive one-third of the total points awarded in each recommendation category. For example, if the homeowner received 10 no-cost, four low-cost and two cost effective recommendations and of those did five no-cost, two low-cost and two cost effective recommendations, the person would receive 50% of the points available.

The points would be awarded by the consulting team based upon an assessment of actions taken at the end of the competition year.

2.22 COMMERCIAL/INDUSTRIAL/INSTITUTIONAL MODULE

Merchants, business owners, etc. requesting energy bus audits would receive a series of cost-effective recommendations to save energy. Points would be awarded based on the actions or proposed actions taken to save energy. The total points in this module are 15,000 and would be awarded to each business, etc. establishment. The 15,000 points would be allocated to each business on a square metre basis.

2.23 MUNICIPAL MODULE

There would be 5,000 points available to be awarded on the basis of cost-effective measures undertaken by both town councils. The points would be awarded by the consulting team based upon a thorough assessment by the engineers.

2.24 TRANSPORTATION MODULE

Most of the savings in auto transportation will be realized by the tuneup etc. done at the clinic. As points have already been awarded for participation in the clinic, no points for this module are to be awarded.

2.25 SUMMARY OF POINTS AWARDED FOR COMPONENT 2.

2.21 Residential Module	30,000
2.22 Commercial/Industrial/Institutional	15,000
2.23 Municipal Module	5,000
2.24 Transportation Module	0
Total Maximum Possible Points	50,000

2.3 COMPONENT 3: MEASUREMENT OF ENERGY SAVINGS

For this component, the engineering consulting team would estimate the overall percentage of energy saved during the competition year. It is proposed that 1,000 points would be awarded for each percentage of energy saved to a maximum of 20,000 points.. If one town achieved more than a 20% saving, then that town would receive 20,000 points and the other would receive a percentage of 20,000 points based on the relative percentage. Thus, if one town saved 25% and the other 15%, then the town saving 25% would receive 20,000 points and the other would receive $\frac{15}{25} \times 20{,}000 = 12{,}000$ points.

III THE AGREEMENT BETWEEN THE TOWNS, THE PROVINCE OF MANITOBA, AND THE GOVERNMENT OF CANADA

This Agreement was made in September __, 1984, between the Town of Stonewall, the Town of Pinawa, the Province of Manitoba, and the Government of Canada.

WITNESSETH: That the parties hereto have agreed as follows:

(1) This Agreement acknowledges the competition guidelines described in this document as fair and acceptable by all parties to this contract.

(2) The parties to this contract agree that the consultants, UNIES Ltd./Appin Solar Associates Inc./E. J. Faraci and Associates Ltd., are the sole judges of the competition.

(3) The parties to this contract agree that any amendments to this Agreement to allow for new contest competitions, etc. as described under the special contests module would represent change orders to this contract.

(4) The following shall become part and parcel of this contract:.

(a) T.E.A.M. minutes of the Pinawa Steering Committee dated March 5, 1984 which state that the Competition Guidelines were approved by the Pinawa Steering Committee and would be signed if approved by Stonewall.

(b) T.E.A.M. minutes of the Stonewall Steering Committee dated March 12, 1984 stating that the Competition Guidelines were accepted unanimously.

C.D. MacInnes Witness	J.H. Gilmour CHAIRMAN, Town of Pinawa Steering Committee
John L Hackman Witness	CHAIRMAN, Town of Stonewall Steering Committee
B. Katin Witness	For Province of Manitoba
R.A. Slason. Witness	L. Dorber For Government of Canada

APPENDIX E

FINAL POINT STANDINGS

TOWN ENERGY AUDIT MATCH

(T.E.A.M.)

FINAL POINTS TOTALS

SUBMITTED TO:

CANADA
ENERGY, MINES AND RESOURCES
ENERGIE, MINES ET RESSOURCES

MANITOBA
ENERGY AND MINES

TEAM STONEWALL COMMITTEE

TEAM PINAWA COMMITTEE

MARCH, 1985

TEAM JUDGES DECLARATION

Mr. G. McVicar,
Manitoba Energy and Mines,
555 - 330 Graham Avenue,
Winnipeg, Man.
R3C 4E3

Dear Grant,

On behalf of the Judges I am pleased to submit our report of the final point totals for the Town Energy Audit Match between Pinawa and Stonewall.

The total points awarded to each town are as follows:

Stonewall - 24,139
Pinawa - 38,970

The Judges declare PINAWA to be the winner of the TEAM competition.

For THE JUDGES

Grant N. Wichenko, P.Eng.

Encl.

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1.0 INTRODUCTION

This report describes the final point summations for the Town Energy Audit Match (TEAM) competition between the towns of Stonewall and Pinawa. The TEAM project was a multi-sector demonstration of energy conservation as applied to entire towns. Under the project, Stonewall and Pinawa competed to reduce energy use and heighten their awareness of energy conservation. The actual competition ran during the 1984 calendar year. Funding for the TEAM Project was provided under the Conservation and Renewable Energy Demonstration Agreement (CREDA) between the Government of Canada and the Province of Manitoba.

To provide a framework for the competition, a set of TEAM Competition Guidelines were designed by the Consultant Team of UNIES Ltd., Appin Solar Associates Inc. and E.J. Faraci & Associates Ltd. The Guidelines were then reviewed and agreed upon by the Stonewall and Pinawa Steering Committees. The Guidelines were designed to reflect the major thrusts of the TEAM program:

- To heighten people's awareness of the need to save energy by encouraging their participation in TEAM activities.
- To encourage people to take action to save energy, based upon information presented in the energy audits and by the program energy auditors.
- To demonstrate that the heightened awareness and individual actions would result in energy savings in both towns.

The Competition Guidelines provided a maximum allocation of 100,000 points per town according to the following distribution:

Component 1:	Heightening Awareness	20,000
Component 2:	Recognition of Actions Taken	50,000
Component 3:	Measurement of Energy Saved	30,000
	Total Available Points	100,000

It should be stressed that the TEAM Competition Guidelines were designed to account for and reflect the natural differences between the two towns (such as the varying number of houses, cars, commercial establishments, etc.).

Members of the Consultant Team were appointed as the Judges of the competition and given responsibility for awarding points and for identifying the winner of the competition. The Judges decision was agreed to be accepted as final.

The following three sections of this report outline the points awarded under the three components. The final section summarizes the point standings and identifies the winning town.

2.0 COMPONENT 1: HEIGHTENING CONSERVATION AWARENESS

2.1 Residential Module

Points were awarded in this Module on the basis of the percentage of dwelling units which requested residential energy audits. Dwelling units included mobile homes, duplexes, and triplexes, but excluded apartments. The maximum score for 100% participation was 5,000 points.

2.1.1 Stonewall

There were 714 dwelling units in Stonewall, of which 296 requested audits. (Originally 298 were reported as audited, but two names were double counted). The points awarded were:

$$\frac{296}{714} \times 5000 = 2,073$$

2.1.2 Pinawa

There were 559 dwelling units in Pinawa (excluding vacant Atomic Energy of Canada Ltd. (AECL) units) of which 345 requested audits. The points awarded were:

$$\frac{345}{559} \times 5000 = 3,086$$

2.2 Industrial/Commercial/Institutional (I/C/I) Module

Points were awarded in this Module on the basis of participation by merchants, industrialists and institution operators in the Energy Bus audit program.

Readers should note that the I/C/I module in Component 1 also included all structures which will be described later under the Municipal Module in Components 2 and 3. The reason for this is as follows: Component 1 is the participation component and participation in the Municipal Module refers to the participation by the Steering Committees in the towns. It was thus decided to structure the Competition Guidelines such that no points would be awarded to the Steering Committees since the fruits of their work would be reflected in the final outcome of the competition. In Components 2 and 3, the actions taken relate to the work of the Town Councils not the Steering Committees. Hence, the Municipal Module is shown as a separate category in these components.

Points were awarded on percentage participation based on square footage[1] of conditioned floor space. There was a maximum of 3,000 points allocated for this Module. Participation was defined as requesting an audit and adequately completing and returning an audit questionnaire form.

A summary of the I/C/I and Municipal Modules statistics together with the total building areas (in square feet) are shown below.

	I/C/I Module		Municipal Module		TOTAL	
	Stonewall	Pinawa	Stonewall	Pinawa	Stonewall	Pinawa
Total audited ft^2	105,840	212,230	230,925	76,113	336,765	288,343
Total non audited ft^2	207,171	7,563	0	0	207,171	7,563
Total ft^2	313,011	219,793	230,925	76,113	543,936	295,906
Buildings audited	22	7	8	5	30	12
Buildings not audited	60	4	0	0	60	4
Total number buildings	82	11	8	5	90	16

2.2.1 Stonewall

There were 543,936 ft^2 of I/C/I and Municipal space, of which 336,765 ft^2 were audited by the Energy Bus or by the Consultant Team. This represented 30 buildings out of a total of 90. The points awarded out of the maximum of 3,000 were thus:

$$\frac{336,765}{543,936} \times 3,000 = 1,857$$

---

1. All data obtained from the provincial tax rolls were in Imperial units and hence it was decided to perform the entire analysis in Imperial units.

2.2.2 Pinawa

There were 295,906 ft² of I/C/I and Municipal space, of which 288,343 ft² was audited by the Energy Bus or by the Consultant Team. This represented 12 buildings out of a total of 16. The points awarded out of the maximum of 3,000 were thus:

$$\frac{288,343}{295,906} \times 3,000 = 2,923$$

It should be noted that there were a number of businesses operating from private homes. These were classified as residential space.

2.3 Transportation Module

The major emphasis in this Module was participation by automobile owners in the car clinics held in each town. All households received a form which permitted it to have one car go through the clinic to receive a tune-up. Points were awarded on the percentage participation by each town in the car clinic program.

There were 715 application forms distributed in each town. Each car going to the clinic received 7 points, for a maximum total of 5,000 points.

2.3.1 Stonewall

A total of 425 cars were analyzed in Stonewall. At 7 points per car, the total points awarded were 2,975.

2.3.2 Pinawa

There were 417 cars, plus 36 AECL vehicles, for a total of 453 analyzed in Pinawa. At 7 points per vehicle, the total points awarded were 3,171.

2.4 Municipal Module

This Module essentially represented each town's Steering Committee activities. As such, no points were awarded in this component for this Module. The work of the committee is reflected in the scores achieved in the other components.

2.5 Attendance at Seminars

Seminars were held in each town for householders and business people on ways to save energy. The Competition Guidelines awarded 5 points for each individual attending the seminars, to a maximum of 3,000 points. For attendance greater than 600 people (600 persons x 5 points per person = 3,000 points) the town with the greater attendance would receive a percentage of the points as compared to the winning town. Thus if one town had 800 persons and the other 500, the winner would receive 3,000 points, whereas the other would receive $\frac{500}{800} \times 3000 = 1,875$ points.

It should be noted that the most recent census figures from the Manitoba Community Handbook show that Stonewall had 1,110 residents between the ages of 20 and 64 and Pinawa had 1,180. Thus the towns had relatively comparable populations.

Part way through the competition year, 1,000 points were transferred from "Attendance at Seminars" to the "School Poster/Essay Contest" to allow a second poster/essay contest to be held in the fall of 1984. As a result only 2,000 points were available for distribution under "Attendance at Seminars".

2.5.1 Stonewall

There were 75 people at the seminar. At 5 points per attendee, Stonewall received 375 points.

2.5.2 Pinawa

There were 32 people at the Pinawa seminar. At 5 points per attendee, Pinawa received 160 points.

Note that more points could have been awarded under this category for both towns, but since there were no more requests from the towns for seminars, no seminars were held and no additional points were awarded.

2.6 School Poster/Essay Contest

One of the most important goals of the TEAM program was to encourage energy conservation among children. It was thus decided that a poster/essay contest be held within each town for children in Kindergarten through Grade 12. Five points were awarded for each child entering a poster or essay, to a maximum of 1,000 points. An adjustment allowance was provided if more than 200 posters or essays were entered. Again, the total points were to be pro-rated or de-rated by the ratio of participants between the two towns. The contest would not be between the towns. Rather, the contest would be within the towns and would be supervised by the town Steering Committees. The competition structure was determined by the towns themselves. The prize selection and judging was done by the Federal and Provincial Governments.

It should be noted that the two towns had relatively comparable school-age populations; Stonewall had 795 persons under age 20 and Pinawa had 810. (Based on the 1982 Manitoba Community Handbook).

There were two poster/essay contests - one in the Spring of 1984 and another in the fall. As previously described, 1,000 points were transferred from "Attendance at Seminars" to the "Poster/Essay Contest" by a Judges' decision on October 23, 1984. Therefore a total of 2,000 points were available for this Module.

2.6.1 Spring 1984 School Poster/Essay Contest (Number 1)

The number of posters and essay submitted for both towns was as follows:

2.6.1.1 Stonewall

Grade	Poster	Essay	Totals
K-3	78	0	78
4-6	109	1	110
7-9	11	1	12
10-12	0	0	0
	198	2	200

2.6.1.2 Pinawa

Grade	Poster	Essay	Totals
K-3	109	0	109
4-6	62	34	96
7-9	30	2	32
10-12	0	0	0
	201	36	237

Since Pinawa submitted more than 200 posters and essays they received 1,000 points, the maximum in the category. Stonewall received a pro-rated share of 1,000 points, or

$$\frac{200}{237} \times 1000 = 844 \text{ points.}$$

2.6.2 Fall 1984 School Poster/Essay Contest (Number 2)

2.6.2.1 Stonewall

Grade	Poster	Essay	Totals
K-3	97	0	97
4-6	145	0	145
7-9	37	0	37
10-12	0	0	0
	279	0	279

2.6.2.2 Pinawa

Grade	Poster	Essay	Totals
K-3	138	0	138
4-6	76	0	76
7-9	15	0	15
10-12	0	1	1
	229	1	230

As both towns submitted more than 200 posters and essays, and as Stonewall submitted more than Pinawa, Stonewall received 1,000 points and Pinawa received

$$\frac{230}{279} \times 1000 = 824 \text{ points.}$$

2.7 Special Contests

Over the course of the competition year a wide range of projects were undertaken by both towns. A total of 3,000 points were reserved for contests, energy fairs, etc. to be awarded at the discretion of the Judges. It was also decided that if there were contests or competitions undertaken by agreement between both towns the competition contract would be amended and points would be awarded by the Judges. However, none were held.

2.7.1 Stonewall

Ward Poem		150 points
	Total points	150

2.7.2 Pinawa

Parker Poem	150 points
Presentation of one play entitled "Crunch, The Energy-Eating Dragon"	750 points
Remounting of this play	300 points
Total points	1,200

3.0 COMPONENT 2: RECOGNITION OF ACTION TAKEN TO SAVE ENERGY

The energy audits performed in the various Modules identified or recommended specific actions to be undertaken to save energy. Points were awarded on the response by householders, business persons, and other building owners/operators to act upon recommendations outlined in the energy audits.

3.1 Residential Module

Each dwelling unit received points for the energy conservation measures undertaken by the homeowner or tenant that were recommended by the auditor. The audit recommendation form developed for TEAM had three components, namely, the no-cost, low-cost (under $100 in materials) and cost-effective recommendations (such as insulation of attics or basements). The homeowner received one-third of the total points awarded in each recommendation category. For example, if the homeowner received 10 no-cost, four low-cost and two cost-effective recommendations, and of those, carried out five no-cost, two low-cost and two cost-effective recommendations, the person would receive 50% of the points available.

The points awarded were based upon a survey of each dwelling unit undertaken by the Judges near the end of the competition. The maximum number of points which could be awarded were 30,000. The 30,000 points were divided by the number of dwelling units in each town to determine the number of points per dwelling unit.

Number of Dwelling Units:	Stonewall	714
	Pinawa	559

Number of potential points per dwelling unit:

Stonewall $\frac{30{,}000 \text{ pts.}}{714 \text{ houses}}$ = 42 points/dwelling unit

Pinawa $\frac{30{,}000 \text{ pts.}}{559 \text{ houses}}$ = 54 points/dwelling unit

The points were award by the Judges based upon an assessment of actions taken or commitments made by the end of the competition year (December 31, 1984).

The data on which the points were awarded was prepared by Mr. T. Ward of Stonewall and Ms. S. Heaney of Pinawa and reviewed by the Judges. The working documents are filed as Appendix I under separate cover to this report.

3.1.1 Stonewall

There were 296 dwelling units audited of which 291 were contacted. Three files were missing and two households could not be contacted. On the basis of this review, a total of 7,329 points were awarded by the Judges.

3.1.2 Pinawa

There were 345 dwelling units audited, and all 345 householders were contacted to determine the work done. On the basis of this review, the Judges awarded 13,995 points to Pinawa.

3.2 Industrial/Commercial/Institutional Module

Merchants, business owners, and institutional operators requesting Energy Bus audits received a series of cost-effective recommendations to save energy. Points were awarded on the basis of actions or proposed actions taken to save energy. The total points available in this Module was 15,000. The points were allocated to each business on a unit floor area basis.

There were 313,011 ft² of I/C/I space in total in Stonewall, and 219,793 ft² in Pinawa. Readers should note that the points per square foot were calculated on the total square footage in both towns - not on the audited square footage. Thus the Judges have assumed that there were no savings made in the non-audited floor space. While this assumption will reduce the energy savings in both towns, it is more reflective of the actual savings in the towns. This means that the number of points per square foot is as follows:

$$\text{Stonewall} \quad \frac{15,000}{313,011} = 0.0479 \text{ point/ft}^2$$

$$\text{Pinawa} \quad \frac{15,000}{219,793} = 0.0683 \text{ point/ft}^2$$

The Judges then administered a survey to all persons owning, operating or renting I/C/I space to determine what actions were taken to save energy.

Only those who had an energy audit done were surveyed. There was a 100% response to the survey. The work done was then assigned a percentage reduction figure by the Judges.

The Judges developed a procedure whereby the savings in each building were weighted by floor area. For example, if 10% of the total energy use was saved in a 2,000 ft² building and in a 3,000 ft² building, the actual energy saved in the 2,000 ft² building would be less than in the 3,000 ft² building, assuming that both buildings had the same unit energy consumption. If the savings had been 10% in the two sample buildings the Judges calculated a "saved floor area". Thus the saved floor area for the 2,000 ft² building was 200 ft², and 300 ft² for the larger building. This total floor area and saved floor area were summed up for both towns. The figures for the saved floor area were multiplied by the points per floor area saved to determine the points awarded for actions taken in this Module. The working notes are filed in Appendix II under separate cover. The figures for both towns are as follows:

3.2.1 Stonewall

There was the equivalent of 2,484 ft² "saved" out of an audited square footage of 105,840 ft². At 0.0479 points per square foot saved, Stonewall received 119 points.

3.2.2 Pinawa

There was the equivalent of 22,514 ft² "saved" out of an audited square footage of 211,630 ft². At 0.0683 points per square foot saved, Pinawa received 1,538 points.

3.3 Municipal Module

There were 5,000 points available to be awarded on the basis of cost-effective measures undertaken by both town councils. The points were awarded by the Judges based on work done or committed by December 31, 1984. Readers are reminded that the Municipal Module which was combined with the I/C/I Module in Component 1 is separated out in this component (see Section 2.2 for further explanation).

The same methodology for calculating the points as used for the I/C/I Module was used for the Municipal Module as well. The working notes are filed under separate cover in Appendix II. The points per square foot saved are as follows:

Stonewall $\frac{5,000}{230,925}$ = .0217 points/ft^2

Pinawa $\frac{5,000}{76,113}$ = .0657 points/ft^2

The points awarded were as follows:

3.3.1 Stonewall

There was the equivalent of 35,810 ft^2 "saved" out of an audited square footage of 230,925 ft^2. At 0.0217 points per ft^2 saved, Stonewall received 777 points.

3.3.2 Pinawa

There was the equivalent of 14,504 ft^2 "saved" out of an audited square footage of 76,113 ft^2. At 0.0657 points per ft^2 saved, Pinawa received 953 points.

4.0 COMPONENT 3: MEASUREMENT OF ENERGY SAVINGS

For this component the Judges have estimated the overall percentage of energy saved during the competition year. It was decided that 1,000 points be awarded for each per cent of energy saved, to a maximum of 30,000 points. If one town achieved more than a 30% saving, then that town would receive 30,000 points and the other would receive a percentage of 30,000 points based on the relative percentage. Thus, if one town saved 40% and the other 20%, then the town saving 40% would receive 30,000 points and the other would receive $\frac{20}{40} \times 30{,}000 = 15{,}000$ pts.

4.1 Residential Module

The Judges constructed a sampling procedure to select a 10% sample of the houses in each town. They then estimated the energy consumption before any retrofit work was done and the savings that could be expected once the work was implemented. Use of energy bills was rejected for two reasons. First, the competition did not run the entire heating season of 1984-85. Secondly, the use of actual energy consumption would vary too greatly due to potential differences in living patterns.

The sample was selected as follows. First the Judges graphed the low no-cost points that the house received against the total points received. The resultant scattergram, shown as Figures 1 and 2 at the end of the document, produced distinct sub-groups, which are given letters on Figures 1 and 2. A 10% sample of these sub-groups was then selected.

The Judges then calculated unit values for the energy consumption before the retrofit and for the saved energy for the sample taken in each town. Thus,

$$\frac{\text{Sum of energy consumed in sample before any retrofit measures}}{\text{Square footage of sample}} = \text{Total energy consumed per ft}^2$$

$$\frac{\text{Sum of energy saved in sample}}{\text{Square footage of sample}} = \text{Energy saved per ft}^2$$

These unit figures were applied to the square footage of all the houses in each town to determine the total energy consumed for the residential components. Thus,

$$\begin{pmatrix}\text{Unit energy consumption}\\ \text{per ft}^2\end{pmatrix} \times \left[\begin{pmatrix}\text{Total ft}^2\text{ of}\\ \text{audited houses}\end{pmatrix} + \begin{pmatrix}\text{Total ft}^2\text{ of}\\ \text{unaudited houses}\end{pmatrix}\right]$$

= Total energy consumed by the residential component.

The energy saved was calculated in the same way, except that the Judges assumed that no energy was saved in the houses that were not audited.

Thus, savings were estimated as follows:

$$\begin{pmatrix}\text{Unit energy}\\ \text{saved per ft}^2\end{pmatrix} \times \begin{pmatrix}\text{Total ft}^2\text{ of}\\ \text{audited houses}\end{pmatrix} = \text{Total energy saved in the residential component.}$$

The working notes for this procedure are attached in Appendix III. The results are set out below, and were used to determine total energy consumption and savings as shown in section 4.4.

The data for both towns is as follows:

	Stonewall	Pinawa
1. Estimated energy consumption in the 10% sample before retrofits (kWh)	958,301	575,265
2. Energy saved in the sample (kWh)	102,020	29,077
3. Total square footage of the 10% sample of houses (ft^2)	29,511	42,616
4. Total audited square footage (ft^2)	314,276	439,277
5. Total square footage not audited (ft^2)	353,877	97,731
6. Unit consumption in the sample before the retrofits were done (kWh/ft^2) (1÷3)[1]	32.47	13.50
7. Unit savings in the sample (kWh/ft^2) (2÷3)	3.46	.68
8. Percentage savings in the sample (7÷6)	10.7%	5.0%

---

[1] This refers to data items 1 and 3.

9. Total residential energy consumption (kWh) [(4+5) x 6]	21,694,928	7,249,608
10. Total energy saved (kWh) (4 x 7)	1,087,395	298,708
11. Estimated % savings in residential consumption (10÷9)	5.0%	4.1%

4.2 Industrial/Commercial/Institutional (ICI) Module

The Judges devised a similar calculation procedure for the I/C/I module for determining energy consumption and savings in energy, as used in the Residential Module (section 4.2). Judges had actual consumption figures and estimated savings from the Energy Bus reports. The Judges then circulated a questionnaire to those I/C/I buildings in both towns which were audited to determine what work was done or proposed to be done. There was a 100% reply to the questionnaire. The consumption data from the audited buldings was used to estimate consumption for all the I/C/I buildings.

Based upon the questionnaire results the Judges estimated percentage reductions for each of the actions that were taken (e.g. installing night setback thermostats). The savings were then tabulated for each building in which work was done.

The Judges used the same total and "saved" floor area calculation that was described in Section 3.2 of this document. These floor area figures were then multiplied by a unit consumption figure of 50 kWh/ft², a figure calculated by the Judges from the consumption data taken from the energy audits. In this way the Judges could estimate the total energy consumption and the consumption savings. The working notes containing the calculation procedures are in Appendix IV.

The data for both towns is as follows:

	Stonewall	Pinawa
1. Total square footage (ft²)	313,011	219,793
2. Audited square footage (ft²)	105,840	212,230
3. "Saved" square footage (ft²)	2,484	22,514
4. Unit consumption used (kWh/ft²)	50	50
5. Total energy consumed (1 x 4)	15,650,550	10,989,650

	Stonewall	Pinawa
6. Total energy saved (3 x 4)	124,200	1,125,700
7. Percentage savings (6÷5)	0.8%	10.2%

4.3 Municipal Module

Readers are reminded that the Municipal Module which was combined with the I/C/I Module in Component 1 is separated out in this component (see section 2.2 for further explanation).

The same methodology for estimated savings as was used in the I/C/I module was used in the Municipal Module. The unit consumption figure of 62 KWh/ft² was calculated by the Judges from the consumption data from the energy audits. The working notes are contained in Appendix IV. The results are as follows:

	Stonewall	Pinawa
1. Total square footage (ft²)	230,925	76,113
2. Audited square footage (ft²)	230,925	76,113
3. "Saved" square footage (ft²)	35,810	14,504
4. Unit consumption used (kWh/ft²)	62	62
5. Total energy consumed (1 x 4)	14,317,350	4,719,006
6. Total energy saved (3 x 4)	2,220,220	899,248
7. Percentage savings (6÷5)	15.5%	19.1%

4.4 Calculation of Energy Saved

	Stonewall		Pinawa	
	Total Energy Consumed	Total Energy Saved	Total Energy Consumed	Total Energy Saved
Residential	21,694,927	1,087,395	7,249,608	298,708
I/C/I	15,650,550	124,200	10,989,650	1,125,700
Municipal	14,317,350	2,220,220	4,719,006	899,248
Total	51,662,827	3,431,815	22,958,264	2,323,656

TOTAL ENERGY SAVED 6.6% 10.1%

At 1,000 points per percentage of energy saved, Pinawa received 10,120 points and Stonewall received 6,640 points.

5.0 SUMMARY OF POINTS AWARDED AND DECLARATION OF THE WINNING TOWN

The points summary is shown in the table following. The section numbers refer to the sections of this document.

5.1 Declaration of the Winning Town

The total points awarded to Stonewall were 24,139. The total points awarded to Pinawa were 38,970.

The Judges therefore declare that PINAWA is the winning town.

5.0 SUMMARY OF POINTS AWARDED

		Stonewall	Pinawa
2.0	COMPONENT 1: HEIGHTENING CONSERVATION AWARENESS		
2.1	Residential Module	2,073	3,086
2.2	Industrial/Commercial/Institutional Module	1,857	2,923
2.3	Transportation Module	2,975	3,171
2.4	Municipal Module	0[1]	0[1]
2.5	Attendance at Seminars	375	160
2.6	School Poster/Essay Contest		
2.6.1	Spring Contest	844	1,000
2.6.2	Fall Contest	1,000	824
2.7	Special Contest Module	150	1,200
	COMPONENT 1 TOTAL	9,274	12,364
3.0	COMPONENT 2: RECOGNITION OF ACTION TO SAVE ENERGY		
3.1	Residential Module	7,329	13,995
3.2	Industrial/Commercial/Institutional Module	119	1,538
3.3	Municipal Module	777	953
	COMPONENT 2 TOTAL	8,225	16,486
4.0	COMPONENT 3: MEASUREMENT OF ENERGY SAVINGS TOTAL	6,640	10,120
	TOTAL POINTS AWARDED	24,139	38,970

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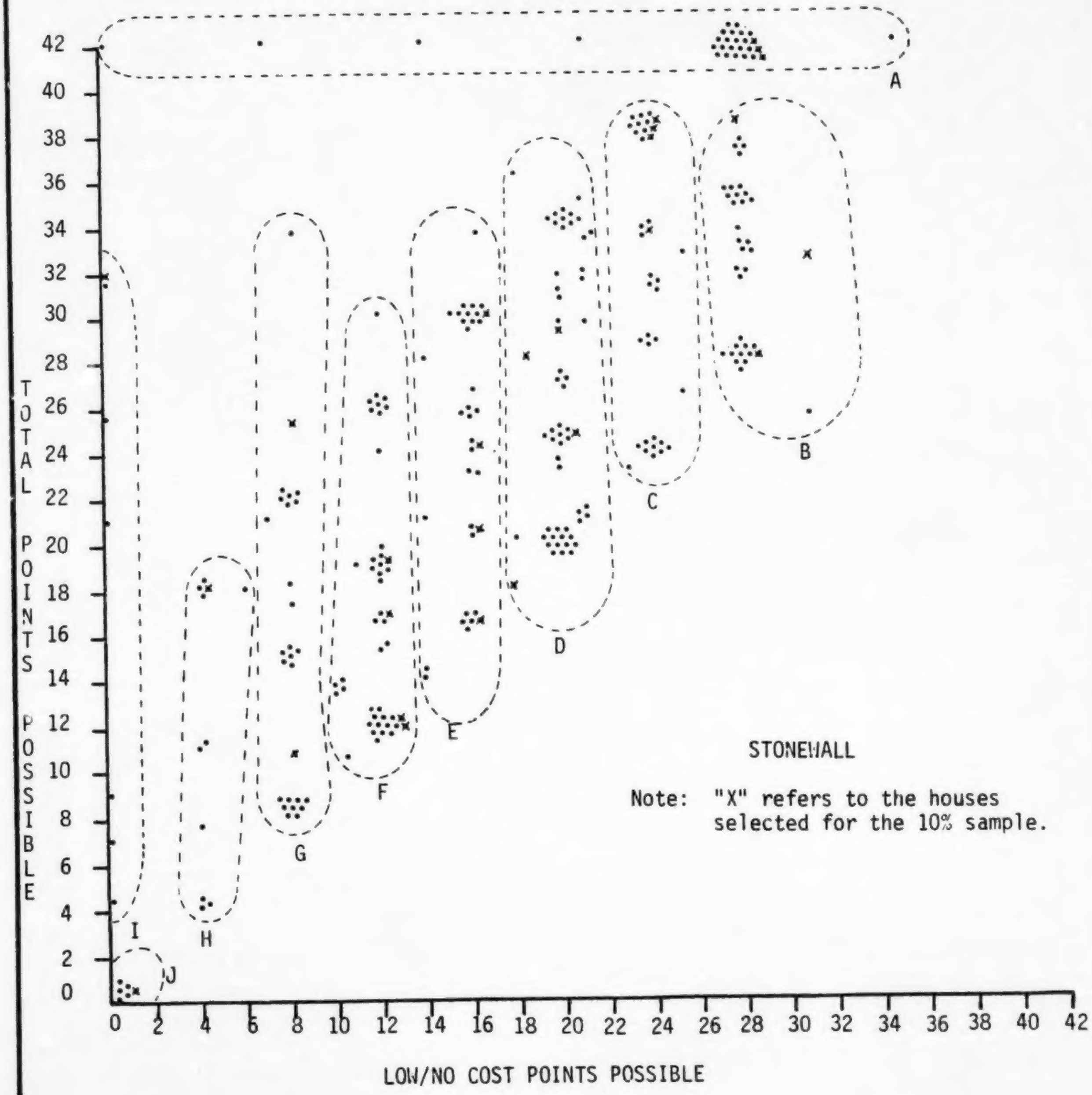
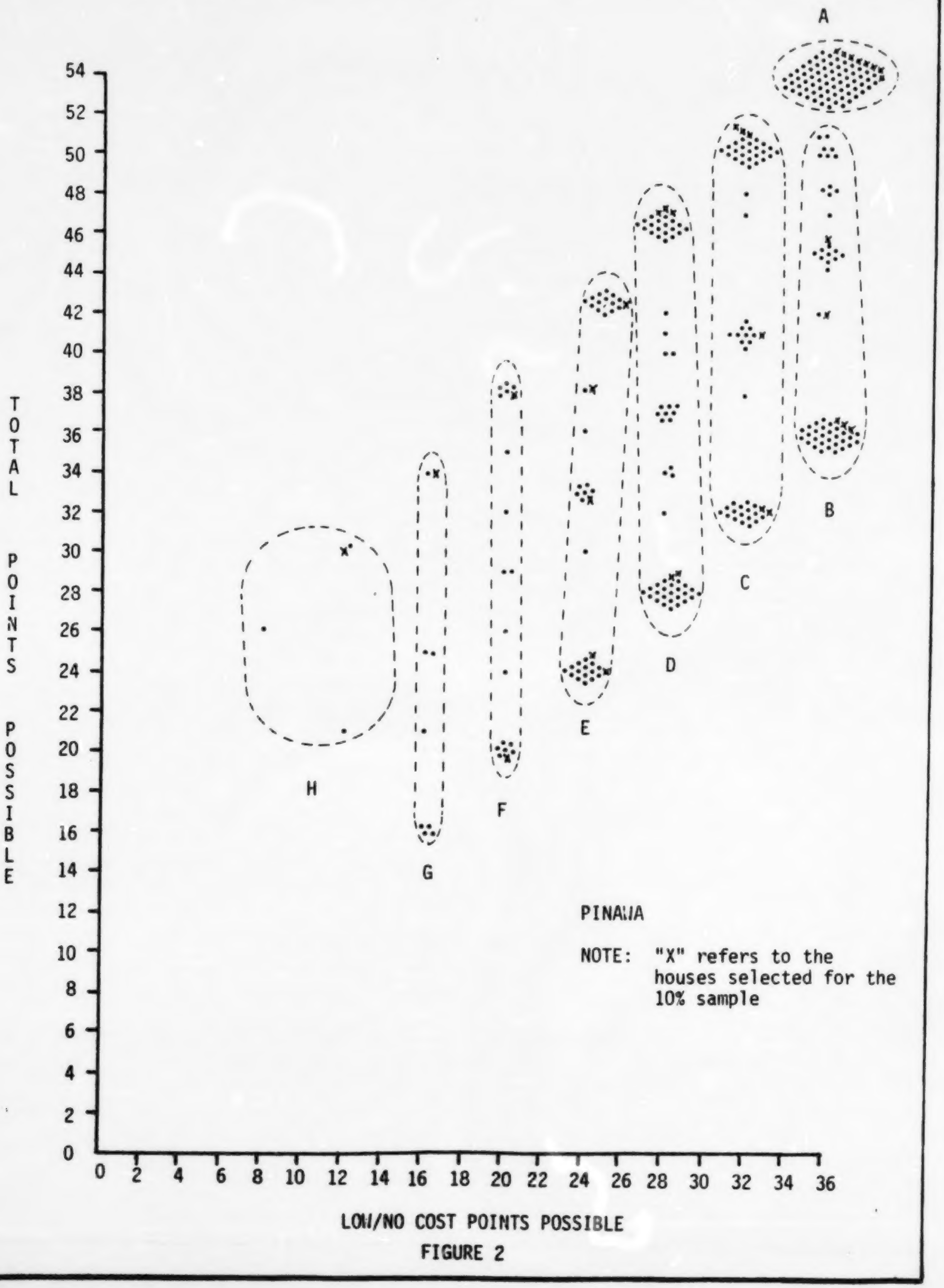
[1] There were no points for the Municipal Module in Component 1.



STONEWALL

Note: "X" refers to the houses selected for the 10% sample.

FIGURE 1



LOW/NO COST POINTS POSSIBLE

FIGURE 2